January 31, 2013

Ms. Christine McConaghy
USEPA Region 5
RCRA Corrective Action Section
77 West Jackson Boulevard, LU-9J
Chicago, IL 60604-3507

Re: *Remedial Action Work Plan*
Tower Automotive Operations USA I, LLC
Elkton, Michigan

Dear Ms. McConaghy:

AMEC Environment & Infrastructure, Inc. (AMEC) is pleased to present the enclosed *Remedial Action Work Plan* on behalf of Tower Automotive Operations USA I, LLC for the facility located at 81 Drettman Drive in Elkton, Michigan (Site). Should you have any questions, please call Ms. Erin Busby at (248) 313-3668.

Sincerely,

Erin Busby, P.E.
Senior Project Manager

Bertisabel Custer, CHMM
Senior Associate

Enclosures
Remedial Action Work Plan (1 hardcopy, 1CD)

cc: Ron Henderson - Tower Automotive Operations USA I, LLC
Matt Eugster – Varnum LLP
(1 CD each)

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REMEDIAL ACTION WORK PLAN
TOWER AUTOMOTIVE OPERATIONS USA I, LLC
81 DRETTMANN DRIVE
ELKTON, MICHIGAN

AMEC Project No. 7-6797-0010

Prepared for:

United States Environmental Protection Agency
Region 5
Chicago, IL

Prepared by:

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January 31, 2013

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1.0 INTRODUCTION

1.1 Site Location and Facility Description

The Tower Automotive Operations USA I, LLC (Tower) facility is located at 81 Drettmann Drive in the Village of Elkton, Huron County, Michigan (Site). The location of the Site is depicted in **Figure 1**. The Site is approximately 53 acres of land occupied by an approximately 1,030,000 square foot (sq ft) main manufacturing building and associated out buildings.

1.2 Project Background

Manufacturing operations began at the Site in approximately 1945. Active Tool and Manufacturing Co, Inc. operated the facility from approximately 1945 until 1999 at which time Tower Automotive, Inc. acquired the Site. Tower purchased the facility and operations out of bankruptcy from Tower Automotive, Inc. on July 31, 2007. A number of buildings were constructed at the Site between 1945 and 2000.

Historical operations at the Site have resulted in several releases and polychlorinated biphenyl (PCB) Aroclors 1248, 1254, and 1260 have been found in soil and drainage ditches on-site. Several investigations were conducted at the Site from 1989 to 2004 to characterize and define impacts to soil, groundwater, and sediment across the Site. Based on the investigations, nine Areas of Concern (AOCs) were identified.

Based on the results of the initial site assessments, additional site characterization activities were required at the facility in accordance with the Toxic Substance Control Act (TSCA) and 40 CFR Part 761, Subpart N. In June and July 2012, AMEC Environment & Infrastructure, Inc. (AMEC) conducted site investigation activities to complete characterization of PCB impacts. The investigation focused on seven AOCs (i.e., AOCs 2, 4, 5, 6, 7/8, and 9). Historical data from previous investigations was used to characterize PCB impacts in the Paint Shed Area (AOC 1) and no investigation was completed in AOC 3 as PCB impacts are not anticipated to be present in this area. A review of the analytical results of the site characterization indicated the presence of PCB impacted soil/sediment in AOCs 1, 2, 4, 7/8, and 9. The location of AOCs with PCB impacted soil/sediment above applicable standards is shown on **Figure 2**. Investigation activities did not show PCB concentrations above laboratory detection limits in the groundwater samples collected. AMEC submitted a *Polychlorinated Biphenyls Site Characterization Report* (Site Characterization Report) to United States Environmental Protection Agency (USEPA) Region 5 in October 2012.

Due to the presence of PCBs in drainage ditches, sewer investigations were completed between November and December 2006 and August and October 2011. These investigations were conducted to confirm the inputs to and the discharge locations of the storm sewer system in designated AOCs. A letter summarizing the results of the sewer investigation can be found in Appendix B of the Site Characterization Report.

Cleanup standards established under the Toxic Substances Control Act (TSCA) 40 Code of Federal Regulations (CFR) Part 761 by USEPA are being proposed for PCB impacted AOCs. TSCA cleanup criteria are specific to each AOC based on Tower's current and future use of the AOCs. Proposed occupancy and corresponding TSCA cleanup standards for each AOC to be remediated is provided in **Table 1**.

1.3 Work Plan Objective

The objective of this Remedial Action Work Plan (Work Plan) is to provide an appr oach to remedial action required to reduce PCB concentrations below required TSCA PCB cleanup standards in the AOCs identified in the Site Characterization Report (AOCs 1, 2, 4, 7/8, and 9). Remedial action activities will include excavation and removal of PCB impacted soil and sediment.

2.0 SITE PHYSICAL CHARACTERISTICS

This section describes the physical characteristics of the surrounding area at the Tower facility.

2.1 Land Use

The Site is situated near the southeast corner of the town of Elkton, Michigan. Agricultural land borders the Site to the east and south. Mill Street is located directly north of the Site, followed by commercial properties. Drettmann Drive is located directly west of the Site, followed by residential properties.

2.2 Topography and Surface Hydrology

The topography of the Site is relatively level, with an approximate elevation of 640 feet North American Vertical Datum (NAVD 88). In general, regional surface relief decreases to the northwest, toward Lake Huron. The Pinnebog River is located approximately 2,500 feet east/northeast of the Site. In addition, exterior drainage ditches are located to the north, south, and northeast of the Site.

The majority of the Site is covered by manufacturing buildings set on concrete slabs. Large asphalt parking lots are located on the southern and northern portions of the Site. Three open air courtyards are located near the center of the building. In the South Courtyard, an enclosed drainage ditch flows to the south, and discharges to an open ditch located toward the southern extent of the Site. In the North Courtyard, an open drainage ditch flows to the north, through the center of the North Courtyard, then becomes enclosed and flows under the building, discharging to an open ditch located at the northern end of the property. Because of the large areas of impermeable materials, rainfall infiltration at the Site is expected to be low, with the exception of the open courtyard areas. Surface runoff, as well as infiltrating rainwater is expected to flow towards the drainage ditches located on and adjacent to the Site. Drainage ditches are shown on **Figure 3**.

2.3 Geology

Geologic information obtained during the field activities is comprised of field observations made during the completion of hollow stem auger, direct-push, and hand-auger soil borings and the collection of soil samples. Regional geologic information was obtained from the MDEQ's GeoWebFace (http://ww2.deq.state.mi.us/GeoWebFace/).

2.3.1 Regional Geology

At depth, the area of the Site is underlain by the Michigan Formation. The Michigan Formation consists of shale, limestone, dolomite, anhydrite, gypsum and sandstone. The formation ranges in thickness from 300 to 350 feet. In the vicinity of the Site, the Michigan Formation is overlain by Quaternary aged deposits of lacustrine clay and silt.

2.3.2 Site Soils

Descriptive boring logs were prepared for soil borings completed during the field activities and soils were visually described using the Unified Soil Classification System (USCS).

In general, soils observed in AOC 2 were composed of a fine to medium sand (SP) interval within the upper 1.5 feet, followed by silty clays (CL) at deeper depths. Soils observed in AOC 4 consisted of silty clays (CL), with sand and silt (SM) making up the first 1 foot of sediments collected from within the ditch. The majority of soils observed in AOC 7 consisted of silty sandy clays (CL) and sandy silts (SM). Soils observed in AOCs 8 and 9 were comprised of silty clays and silty sandy clays (CL).

2.4 Hydrogeology

Regional and local groundwater migration is strongly influenced by surface drainage, topography, and the permeability of subsurface materials. Depth to groundwater and groundwater flow direction are expected to be seasonally variable in the vicinity of the Site. Groundwater regionally is anticipated to flow to the north/northeast toward the Pinnebog River and Lake Huron. Groundwater monitoring wells installed during previous field activities indicate shallow groundwater levels between 3 and 4 feet below ground surface (bgs) in the courtyard areas of the Site, and approximately 9 feet bgs on the northern portion of the Site.

3.0 CONCEPTUAL SITE MODEL

AMEC developed the Conceptual Site Model (CSM) for the Tower Facility during site characterization activities to identify potential migration pathways for PCBs. Historical operations at the Site have resulted in several releases and subsequent subsurface impacts. PCB Aroclors 1248, 1254, and 1260 have been found in soil and drainage ditches on-site.

The current contaminant sources at the Site are considered to be soil and sediment impacted by PCBs. The PCB-impacted materials may contribute to groundwater impacts beneath the Site; however a review of historical data indicates that PCBs are non-detect in groundwater at the Site. Recent groundwater sampling efforts (during the site characterization activities) also show that impacts have not migrated to groundwater. Additionally, precipitation runoff may transport PCB-impacted material to drainage ditches and other physical processes such as winds may move particulates.

3.1 Subsurface Geology and Groundwater Flow

The soils observed at the Site consist of fine grained materials including clays, silts, and fine-grained sands. On a regional scale, the Site is underlain by Quaternary aged deposits of lacustrine silt and clay, followed by shale, limestone, dolomite, anhydrite, gypsum and sandstone of the Michigan Formation at depth. As impacts at the Site appear to be limited to the upper 2 feet of soil/sediment, the infiltration of rainwater and overland sheet flow of water during precipitation events are of primary concern for the Site. Due to the large area of the Site covered with impermeable surfaces, precipitation is directed to, and preferentially travels along, the drainage ditches across the property. The drainage ditches have the potential to act as a conduit for the migration of impacted soil/sediment, as indicated by the concentrations of PCBs observed within the drainage ditch areas.

3.2 Fate and Transport of PCBs

The potential for transport of PCBs at the Site is described below.

3.2.1 Aqueous Infiltration and Groundwater Transport

One potential transport pathway for PCBs may be based on the assumption that soil-bound contaminants may leach vertically downward to the groundwater table with infiltrated rainwater. When reaching the groundwater, the dissolved chemicals would migrate laterally with the groundwater at the Site. The assumed groundwater gradient is directed to the east/northeast, and dissolved contaminants would travel preferentially in this direction. However, PCBs are characterized by low aqueous solubility and high organic carbon partition coefficients. These parameters demonstrate an affinity of PCBs to bond with available organic carbon in soil and a resistance to aqueous transport.

Historical analytical data as well as recent groundwater samples obtained from three monitoring wells at the Site show PCBs were not detected at concentrations greater than the laboratory reporting limit. On the basis of these facts, the infiltration of rainwater may be considered a

potential migration pathway, but has not been demonstrated as a complete pathway at the Site. However, completion of this potential pathway is considered a low probability occurrence.

3.2.2 Surface Water Transport

PCBs are persistent in the environment, have low aqueous solubility, and a strong affinity to bond with the organic carbon content in soils. In general, the greatest PCB concentrations observed at the Site were found in the upper 2 feet of soils/sediments. These soils/sediments are characterized as clays, silts, and fine-grained sands. Infiltration rates during rainfall events are anticipated to be low in these soil types and surface runoff may transport suspended sediments. Large portions of the Site are covered by impermeable material (*i.e.*, concrete slabs and metal buildings) that will increase the overland runoff volume. Therefore, a potential transport pathway is considered to be precipitation runoff carrying eroded PCB-impacted sediments.

The runoff waters will likely travel to the drainage ditches on the Site and, in general, will travel from the south to the north. The northernmost drainage ditch discharges to an unnamed waterway which continues north, eventually discharging into the Pinnebog River. Groundwater flow is currently and has historically been controlled by three weirs. The locations of the weirs are depicted on **Figure 3**. As the surface water passes a weir, it is expected that the slowed flow would cause sediment to be deposited within the drainage ditches.

3.2.3 Airborne Particulate Transport

As noted previously, the greatest PCB concentrations at the Site were reported in fine-grained surface soils. Areas of the Site with identified PCB concentrations are covered in vegetation, ranging from low-cut grass/weeds in the courtyards to un-manicured cattails and tall bushes in the drainage ditches. The presence of the vegetation limits the likelihood of erosion and transport of impacted soil and sediment by high winds. Wind transport of particulates may be considered a potential PCB migration pathway at the Site; however, the current state of the ground surface cover makes migration via this pathway unlikely.

4.0 SUMMARY OF SITE CHARACTERIZATION

This section summarizes PCBs detected in soil, sediment, and groundwater at the Site in concentrations exceeding the applicable screening criteria. For the purposes of this Work Plan, proposed cleanup standards for PCB concentrations in environmental media has been defined for both low-occupancy and high-occupancy occurrences in accordance with 40 CFR Part 761.

- A **low-occupancy** occurrence is satisfied when unprotected individuals may occupy an area presenting non-porous surfaces containing PCBs for less than 840 hours per year, or an area presenting porous surfaces containing PCBs for less than 335 hours per year. The cleanup criterion for low-occupancy areas is 25 part per million (ppm).

- **High-occupancy** occurrences are satisfied when an unprotected individual may occupy these areas for greater than 840 hours per year or greater than 335 hours per year, respectively. The cleanup criterion for high-occupancy areas is 1 ppm.

TSCA cleanup criteria are specific to each AOC based on Tower's current and future use of the AOCs. Proposed occupancy and corresponding TSCA cleanup standard for each AOC is provided in **Table 1**.

4.1 Soil and Groundwater Sample Summary

4.1.1 Soil Samples

In summer 2012, a total of 126 soil borings were completed in the vicinity of AOCs 2, 4, 5, 6, 7/8, and 9 using a direct push rig or hand auger. Soil borings were advanced to the maximum depths specified for each AOC in the October 2010 *Work Plan for Polychlorinated Biphenyl Characterization* by AMEC. Select soil samples were submitted to an off-site laboratory for analysis of PCBs in accordance with USEPA SW-846 Method 8082. Samples were analyzed incrementally by depth. That is, upon receipt of initial analytical results, select additional soil samples were taken off hold and analyzed for PCBs in accordance with USEPA SW-846 Method 8082. In general, if the analytical results of the initial soil sample were detected above applicable screening criteria, the next subsequent depth interval was analyzed for that boring location.

Results of the site characterization were combined with data from historical investigations and analyzed to evaluate each AOC and are presented in the Site Characterization Report. Based on the results it was determined that AOCs 1, 2, 4, 7/8, and 9 contain PCB impacted soil/sediment above applicable standards. A summary of samples collected in each PCB-impacted AOC is presented in **Table 2** and the analysis is summarized for in the following sections.

<u>AOC 1 – Paint Shed Area</u>

Historical site investigations indicate that PCB impacts in AOC 1 are at relatively low levels and limited in extent. Historical operations in the Paint Shed area also suggests that PCB impacts in

AOC 1 are likely confined to a small area. As a proactive measure, Tower will excavate the impacted area will be excavated and post-excavation confirmatory sampling will be conducted to document that impacts have been remediated. It is anticipated that AOC 1 will be designated as a high occupancy area and a cleanup standard of 1 ppm for PCBs.

AOC 2 – South Courtyard

A total of 44 soil borings were completed in AOC 2 during 2012 site characterization activities. Seven of the soil borings were advanced to a depth of 6 feet bgs, with discrete soil samples collected from 2, 3, 4, 5, and 6 feet below ground surface (bgs). One of the soil borings was advanced to a depth of 5 feet bgs, with discrete soil samples collected from 2, 3, 4, and 5 feet bgs. Nine of the soil borings were advanced to a depth of 2 feet bgs, with discrete soil samples collected from 0.5-1, 1-1.5, and 1.5-2 feet bgs. The remaining 27 soil borings were advanced to a depth of 1.5 feet bgs, with discrete soil samples collected from 0-0.5, 0.5-1, and 1-1.5 feet bgs. The uppermost interval of soil collected from each boring (44 soil samples total) and seven duplicate soil samples were submitted for laboratory analysis.

PCB impacts in AOC 2 were observed along the eastern portion of the south courtyard, in the vicinity of the former transformer #11. In general, impacts decrease with increasing depth, with the exception of historic sampling point TP/S-53. No impacts exceeding 25 ppm were observed at depths greater than 1.5 feet bgs. It is anticipated that AOC 2 will be a low occupancy area with a cleanup standard of 25 ppm for PCBs.

AOC 4 – North Courtyard

A total of nine soil borings were completed in AOC 4 during 2012 site characterization activities. Six of the soil borings were advanced to a depth of 2 feet bgs, with discrete soil samples collected from 0-0.5, 0.5-1, and 2 feet bgs. Three of the soil borings were advanced to a depth of 2 feet bgs, with discrete soil samples collected from 0-1 and 2 feet bgs. The uppermost interval of soil collected from each boring (9 soil samples total) and three duplicate soil samples were submitted for laboratory analysis.

PCB impacts in AOC 4 were observed within the banks of the drainage ditch at the northern and southern extents near the center of the drainage ditch. In general, detected PCB concentrations decreased with increasing sample depth. No impacts greater than 1 ppm were observed at depths greater than 1 foot bgs. It is anticipated that AOC 4 will be designated as a high occupancy area and a cleanup standard of 1 ppm for PCBs.

AOC 7/8 – Drainage Ditch Area

A total of 48 soil borings were completed in AOC 7/8 during 2012 site characterization activities. A total of 47 of the soil borings were advanced to a depth of 2 feet bgs, with discrete soil samples collected from 1-1.5 and 1.5-2 feet bgs. One of the soil borings was only advanced to a depth of 1.5 feet bgs due to repeated collapse of the borehole; a discrete soil sample was collected from 1-1.5 feet bgs. The uppermost interval of soil collected from each boring (48 samples total) and 13 duplicate soil samples were submitted for laboratory analysis.

PCB impacts in AOC 7/8 were observed within the drainage ditch as well as along the banks. In general, detected PCB concentrations decreased with increasing sample depth. Three samples exceed the screening criterion at a depth of 2 feet bgs in AOC 7/8; deeper samples were not collected at these boring locations. It is anticipated that AOC 7/8 will be designated as a high occupancy area and a cleanup standard of 1 ppm for PCBs.

AOC 9 – On-Site Drainage Ditch Sediments

A total of 17 soil borings were completed in AOC 9 during 2012 site characterization activities. Fifteen of the soil borings were advanced to a depth of 2 feet bgs, with discrete soil samples collected from 1-1.5 and 1.5-2 feet bgs. Two of the soil borings were only advanced to a depth of 1.5 feet bgs due to repeated collapse of the bore holes; a discrete soil sample was collected from each of these borings from 1-1.5 feet bgs. The uppermost interval of soil collected from each boring (17 samples total) and three duplicate soil samples were submitted for laboratory analysis.

PCB impacts in AOC 9 were observed generally between the building and the weir. Impacts do extend somewhat beyond the weir as well as at the bends of the ditch near northern extent of the Site. In general, detected PCB concentrations decreased with increasing sample depth. It is anticipated that AOC 9 will be designated as a high occupancy area and a cleanup standard of non-detect for PCBs.

4.1.2 Groundwater Sample Results

Three groundwater samples were analyzed for PCBs in accordance with USEPA Method 8082. A review of the laboratory results indicates that detected PCB concentrations were less than the laboratory reporting limits for each of the samples. The laboratory reporting limits ranged from 0.00028 to 0.00061 ppm. In order to document that PCBs have not migrated to groundwater, semi-annual sampling of the three existing groundwater monitoring wells will be conducted for one year. No further action is proposed in this Work Plan with respect to groundwater.

5.0 REMEDIAL ACTION OBJECTIVES

Based on a review of analytical results obtained during the site characterization, remedial action objectives include recommendations to address PCB impacts to soil and sediment at the Site. The proposed remedial action activities include excavation and removal of PCB contaminated soil and sediment, regrarding of the existing drainage ditch, and replacement of sections of existing enclosed storm sewer.

A review of groundwater analytical results from the site characterization activities indicated PCB concentrations below laboratory detection limits. Therefore, this work plan does not propose remedial actions for groundwater at the Site. However, in order to document that PCBs have not migrated to groundwater, semi-annual sampling of the three existing groundwater monitoring wells will be conducted for one year.

A review of site characterization data indicated soil and sediment PCB concentrations exceed applicable TSCA screening criteria in AOC 1, 2, 4, 7/8, and 9. Therefore, remedial activities include the excavation and removal of the impacted soil and sediment. Proposed excavation depths range from 6 inches to 24 inches bgs. In conjunction with PCB-impacted soil and sediment removal, modifications to the storm sewer and drainage ditches in AOCs 2 and 4 may be completed.

6.0 REMEDIAL ACTION IMPLMENTATION

Remedial actions will be implemented at the Site to reduce PCB concentrations below proposed TSCA cleanup standards. TSCA cleanup standards are specific to each AOC based on Tower's current and future use of the AOCs. Proposed occupancy and corresponding TSCA cleanup criteria for each AOC is provided in **Table 1**.

6.1 Pre-Implementation Activities

The pre-implementation activities conducted prior to initiating remedial action activities at the Site include review of the Health and Safety Plan (HASP), completion of a storm sewer design, and acquisition of required permits. In addition, Tower plans to temporarily or permanently relocate the existing transformer in AOC 2.

6.1.1 Health and Safety

A Health and Safety Plan (HASP) is included in **Appendix A**. The HASP includes soil excavation activities and installation of a storm sewer and outlines the required monitoring for organic vapor and PCBs/dust. The HASP will be on-site during all remedial activities. Prior to the initiation of remedial activities, the HASP will be reviewed with on-site personnel and the review will be documented within the HASP. Additionally, field personnel will conduct daily safety briefings prior to the start of work each day.

6.1.2 Permits

Permits will be maintained on Site for the duration of remedial construction activities. Copies will be available to USEPA upon request. To the extent necessary for the work, the following permits are expected to be obtained.

Soil Erosion and Sediment Control (SESC)

Although the combined excavation areas are less than 0.5 acre, the excavation areas are within 500 ft of the county drainage ditches and will require an SESC permit. The SESC permit will be obtained by the contractor prior to soil disturbance. It is anticipated that the once an application is submitted to the county, a permit can be obtained in two to three days.

Michigan Department of Transportation (MDOT)

The soil/sediment in AOC 7/8 and 9 is within the MDOT right-of-way. In order to remove the required soil and sediment within the AOCs, a permit will need to be obtained to perform work within a MDOT right-of-way. Obtaining the required MDOT permits is expected to take 60 to 90 days and will be initiated prior to contactor procurement.

Huron County Drain Permit

As part of the remedial action, soil/sediment will be removed in and around county drainage ditches. A permit will be required to work in a county drainage ditch and within the county drain right-of-way. The permit is expected to require submission of storm sewer design drawings and specifications as well as drawings depicting proposed excavation areas. It is anticipated that

the Huron County Drain Commissioner will review and issue a permit within two weeks upon receipt of submission. The permit will be obtained by the contractor prior to mobilization.

Michigan Department of Environmental Quality (MDEQ) Permit

A permit will be required to work in the open drainage ditch and to install enclosed piping within the existing open drainage ditch. The permit is expected to require submission of storm sewer design drawings and specifications as well as drawings depicting proposed excavation areas. The permit may take up to 120 days to acquire. The permit will be obtained by the consultant prior to mobilization.

National Discharge Permit Elimination System (NPDES) Permit

A NPDES permit will be required if treated storm water is discharged into the country drain rather than stored in 55-gallon drums (or bulk containers) and disposed off site. It is anticipated that the construction will be completed in dry weather and that storm water will be minimal. However, if construction cannot be rescheduled due to inclement weather, Tower may decide to treat and discharge storm water on-site.

6.1.3 Storm Sewer Design

In order to obtain a permit from the Huron County Drain Commissioner or MDEQ, a design of the storm sewer will need to be completed. The design may include location of proposed finished elevations of open ditches, enclosed drain sections to be replaced, pipe material and size, pipe inverts, tie-ins with existing roof drains, and catch basins. The storm sewer design will be available to the USEPA upon request.

6.2 Site Preparation Activities

Site preparation activities will be completed in advance of the initiation of excavation activities to prepare the Site. The proposed activities are described below.

6.2.1 Clearing and Grubbing

To provide access to the excavation areas, the contractor will clear vegetation less than 6 inches in diameter. SESC best management practices (BMPs) will be implemented prior to the start of clearing and grubbing activities. Vegetated material will be temporarily staged on-site and disposed with the excavated soils.

6.2.2 Erosion and Sediment Control

SESC BMPs will be designed and implemented by the contractor based on their means and methods to complete the work. At a minimum, BMPs will consist of silt fence, geotextile inlet protection, and decontamination pad. A SESC permit will be obtained prior to soil disturbance.

6.2.3 Utility Locate

Prior to initiating remedial activities at the Site, the contractor will call MissDig, the Michigan One-Call System for utility location. The contractor will provide the ticket number and it will be

recorded in the field book. In addition to MissDig, a private utility locator will be procured to assist with the identification of utilities on the Site.

6.3 Soil Excavation Activities

Soil and sediment impacted with PCBs at concentrations exceeding the proposed cleanup criteria will be excavated, stockpiled (or direct loaded), and transported off site for proper disposal as TSCA waste. Soil will be transported to a TSCA-approved landfill and disposed in accordance with 40 CFR § 761.61(a)(5)(v).

The minimum excavation limits are depicted on **Figure 4 through 7**. An estimated 636 cubic yards (yd^3) of soil will be removed from the Site. Minimum excavation areas and volumes for each AOC are provided in **Table 3**.

Existing characterization data is expected to be used for waste characterization prior to disposal. Depending on site conditions at the time of excavation activities within the drainage ditches, a dewatering pad may need to be constructed for the sediments. Handling and disposal of waste is discussed in **Section 6.7**.

It is anticipated that the excavation activities will begin in AOCs 7/8, and 9 and then proceed to AOCs 4, 2, and 1. Since the majority of excavation will be performed in the drainage ditches, scheduling of soil/sediment removal will be based on storm water management. Storm water management is discussed in **Section 6.5**. Soil excavation will be conducted to specific depths based on analytical results obtained during the site characterization. Soil with PCB concentrations exceeding the proposed cleanup standards will be removed from the Site. The excavation depths are anticipated to extend to a maximum of 2 feet bgs. Additional excavation below 2 feet bgs may be required if verification sampling indicates PCB concentrations exceed proposed cleanup standards on **Table 1**.

In order to access AOC 4, equipment and personnel will need to travel through the active facility. It is anticipated that soil removed from AOC 4 will be stockpiled in the courtyard and transported through the facility in lined and covered containers in the afternoons, when minimal facility personnel are on-site. Stockpiled soil and containers that contain soil will be staged in the waste staging area as described in **Section 6.7**. A traffic control layout will be prepared prior to initiating field activities which will include location of the waste staging area and decontamination pad.

6.4 Storm Sewer Installation

An enclosed storm sewer may be installed to replace the open drainage ditch in AOC 4 and the enclosed storm sewer in AOC 2 may be replaced. Modifications will not begin until the PCB impacted soil is removed from the AOCs. Waste generated during the removal and installation of piping will be stockpiled and removed with the PCB-impacted soil removed from AOCs 1, 2, and 4.

6.5 Storm Water Management

Work will be sequenced in order to provide minimal disruption to the flow of the drainage ditches. During excavation activities in the AOCs, storm water will be redirected to flow in the drainage ditches on the eastern portion of the Site. Storm water that flows though PCB-impacted drainage ditches will be rerouted so that it does not flow through an AOC that has already been remediated. When working within an AOC, effort will be made to collect storm water that comes in contact with PCB contaminated soil/sediment. It is anticipated that collected storm water will be containerized in 55-gallon drums (or bulk containers) and placed in the waste staging area for characterization and disposal. However, an NPDES permit may be acquired to discharge treated water.

6.6 Verification Sampling, Analysis, and Evaluation

Post-excavation samples will be collected from the floor and walls of the excavated areas. Verification samples will be collected per the requirements of 40 CFR 761.283. The samples will be composited at no more than a 4:1 ratio following general requirements of 40 CFR 761.289 within the area of influence. Each soil sample will be assigned a unique identification based on the location of the sample. This section describes sampling methods, sample handling procedures, and sample analysis.

6.6.1 Collection of Soil Samples

Soil samples collected from the floor and walls of excavated areas will be collected using stainless-steel trowels. The remainder of this subsection describes the equipment and procedures used for soil sample collection using a stainless-steel trowel and general soil sampling procedures. Soil samples will be collected in accordance with the USEPA *Region IV Science and Ecosystem Support Division, Operating Procedure, Soil Sampling, SESDPROC-300-R1, December 2011.*

The trowel will be decontaminated and checked for defects prior to collection of each soil sample. A description of the location of the sampling area, field observations, and sample description will be recorded in a field logbook. Soil samples will be collected with a decontaminated trowel and placed into a decontaminated stainless steel bowl. The sample will be homogenized in the stainless-steel bowl, placed in a laboratory-supplied container, properly labeled, and stored in an iced cooler prior to shipment to the laboratory. Soil samples will be submitted under proper chain of custody protocol to the designated laboratory.

To prevent cross-contamination of samples, field personnel will don clean, disposable, powder-free nitrile gloves prior to collecting each soil sample. Field personnel will decontaminate stainless-steel hand trowels and bowls between sample locations. Decontamination of sampling equipment will follow the U.S. EPA *Region IV Science and Ecosystem Support Division, Operating Procedure, Field Equipment Cleaning and Decontamination, SESDPROC-205-R1, December 2011.* Decontamination procedures will include removing residual soil particles from the sampling equipment, rinsing with potable water, washing with a non-phosphate detergent, rinsing with distilled water, rinsing with hexane solution, and a final rinse with deionized water. The sampling equipment will then be wrapped with aluminum foil for

transport to the next sampling location. Decontamination water will be stored in a DOT approved, 55-gallon drum pending characterization and disposal.

A *Field Sampling and Analysis Plan* (SAP) is included in **Appendix B**. The SAP includes additional details regarding sampling procedures including sampling nomenclature, frequency, and total number of samples per AOC.

6.6.2 Quality Assurance Samples

Quality assurance samples, including matrix spike/matrix spike duplicates, duplicate samples, equipment rinsate blanks, and trip blanks will be collected in accordance with the procedures described in the site-specific *Quality Assurance Project Plan* (QAPP) (**Appendix C**). Following sample collection, the containers will be placed in a cooler with ice. Samples will be shipped via overnight courier to the laboratory under proper chain of custody protocol.

Matrix spike/matrix spike duplicate (MS/MSD) samples provide a measurement of matrix effects, in which other sample components interfere with the analysis of the contaminants of interest. The laboratory will be supplied with sufficient sample volume to perform matrix spike and matrix spike duplicate analyses at a rate of one MS/MSD duplicate per twenty samples.

The analysis of blind duplicate samples provides a means of evaluating the relative precision of the sample collection and analytical procedures. An important factor in evaluating the analytical data from sample pairs is the homogeneity of the analyte within the sample matrix. Therefore, filed personnel will homogenize sample aliquots from discrete locations planned for a duplicate sample prior to containerizing the sample and duplicate. Duplicate samples will be collected at a rate of one duplicate per twenty samples.

Equipment rinsate blanks provide a measurement of cross contamination that may occur between sampling locations due to insufficient decontamination procedures. AMEC will collect an equipment rinsate blank by passing distilled, deionized water over decontaminated soil sampling equipment. Equipment rinsate blanks will be collected at a rate of one equipment rinsate blank per twenty samples.

Additional details regarding quality control for the Work Plan are outlined in the QAPP.

6.6.3 Sample Handling and Analysis

Samples will be collected and handled to prevent cross-contamination. Field personnel will don new, clean disposable powder-free nitrile gloves prior to collecting or handling samples. Sampling equipment will be decontaminated in the field prior to use and between sampling locations. Samples will be placed on ice until delivered to the laboratory. The sample jars will be wrapped in bubble wrap and placed in plastic bags prior to placement in coolers and shipment to designated laboratory.

6.6.4 Verification Sample Evaluation

Analytical results of verification soil samples collected from the wall and floor of the excavations will be evaluated to document that residual PCB concentrations are below proposed cleanup standards at each AOC. Verification sampling will be performed in general accordance to 40 CFR 761 Subpart O. If the post-excavation concentration exceeds proposed cleanup standard, additional excavation will be conducted in the area. Following the additional excavation activities, additional verification samples will be collected. If the PCB concentration is detected below the proposed cleanup standard, the excavation activities will be considered complete.

6.7 Remediation Waste Handling and Disposal

The excavated surface soil will be placed in a secured, well marked waste staging area on plastic sheeting and soil stockpiles will be covered with plastic daily. Alternatively, soil may also be placed directly into rolloff containers and covered daily. Temporary fencing will be installed around the waste staging area to prevent entry by unauthorized personnel. Silt fencing and straw bales will also be placed around the stockpiled material.

It is anticipated that the sediments in AOC 9 can be mixed with the soil removed from AOC 7 and 8 prior to waste characterization and removal from the Site. However, if the sediments are fully saturated at the time of excavation, a dewatering pad may need to be constructed for the sediments. The pad will be constructed to drain to a sump to containerize the water. The contractor will remove water from the sump as needed and containerize the material in 55-gallon drums (or bulk containers) for characterization and disposal or discharge under an NPDES permit.

The specific analyses required for waste characterization and the frequency of sampling will depend on the requirements of the selected disposal facilities. Liquid waste generated during decontamination of equipment will be stored in DOT-approved 55-gallon drums (or bulk containers). The material will be sampled for characterization as required by the disposal facility. Waste generated during remedial activities will be transported by licensed waste haulers to appropriately permitted facilities.

6.8 Backfill and Site Restoration

Following review of the confirmation sampling results, the excavation areas will be backfilled and the Site will be restored to the approximate grade prior to remedial activities. The drainage ditches will be shaped to maintain proper flow of site storm water.

Prior to transport to the Site, a sample of the proposed backfill will be analyzed for volatile organic carbons (VOCs), SVOCs, PCBs, pesticides, and RCRA 8 metals. Analytical results will be compared to September 28, 2012 Michigan Department of Environmental Quality (MDEQ) Residential Part 201 Generic Cleanup Criteria and Screening Levels (Generic Residential Criteria) outlined in Operational Memorandum 1, Attachments 1 and 2. If the concentrations are below the Generic Residential Criteria, the backfill will be transported to the Site for placement. Approximately 6 inches of topsoil will be placed over the disturbed area prior to the placement of permanent seeding.

6.9 Demobilization

Following Site restoration, personnel will decontaminate equipment prior to transport off site. Decontamination will include removal of material from the equipment with shovels and scrapers followed by a high-pressure wash and rinse. Waste material generated during equipment decontamination will be placed into the waste stockpile and decontamination water will be containerized in DOT approved 55-gallons drums for characterization and disposal. Heavy equipment will be decontaminated on the decontamination pad prior to leaving the Site.

6.10 Post-Implementation Activities

The remedial activities are intended to remove soil at the Site impacted with PCBs that could pose a threat to human health and the environment.

A progress report will be submitted to the USEPA every two weeks throughout the remedial activities implementation. The progress reports will include information on the status of the remedial activities and will provide notification of modifications to the schedule. The progress reports will include the following elements:

- A description of activities that occurred during the reporting period;
- A summary of contacts with representatives of the local community, public interest groups, or State government;
- A summary of problems or potential problems encountered;
- Actions taken or planned to address the problems;
- Changes in personnel;
- Projected work for the next reporting period; and
- A summary of data generated during the reporting period.

Following completion of the remedial activities, a final report will be submitted to USEPA that includes a description of the remedial activities, a discussion of sampling results, and copies of waste manifests.

6.11 Project Schedule

It is anticipated that construction activities will take one month to complete. After approval of this Work Plan, Tower plans to bid the project for completion during the 2013 construction season. However, it should be noted that the schedule may be affected by inclement weather that is common in the area of the Site. USEPA will be notified prior to the start of construction activities and as noted previously, progress reports will be submitted every two weeks to the USEPA which will include the status of the remedial action implementation and will provide notification of modifications to the schedule, if changes become necessary. Assuming timely receipt of permits, the characterization activities can be completed in accordance with the schedule below.

Activity/Deliverable	Scheduled Start	Scheduled Completion
Submittal of Work Plan to USEPA		January 31, 2013
EPA Review of Work Plan	Upon receipt of Work Plan	60 days after receipt of Work Plan
Contractor Procurement by Tower	Upon USEPA approval of Work Plan	30 days after approval of Work Plan
Obtain Necessary Permits (includes preparation of documents needed for permit applications)	Within 14 days of awarded contract	150 days after start
Construction	Within 14 days of receipt of permits	30 days after mobilization
Reporting	Upon completion of construction	Within 90 days after completion of construction activities

7.0 REFERENCES

AMEC 2012, *Final Polychlorinated Biphenyls Site Characterization Report*, Tower Automotive Operations USA I, LLC, 81 Drettmann Drive, Elkton, Michigan. AMEC Environment & Infrastructure, Inc., Novi, Michigan. October 2012.

AMEC 2010. *Final Work Plan for Polychlorinated Biphenyls Characterization*, Tower Automotive Operations USA I, LLC, 81 Drettmann Drive, Elkton, Michigan. AMEC Earth & Environmental, Inc., Brighton, Michigan. October 2010.

AMEC 2010. *Final Sampling and Analysis Plan*, Tower Automotive Operations USA I, LLC, 81 Drettmann Drive, Elkton, Michigan. AMEC Earth & Environmental, Inc., Brighton, Michigan. October 2010.

AMEC 2010. *Health and Safety Plan*, Tower Automotive Operations USA I, LLC, 81 Drettmann Drive, Elkton, Michigan. AMEC Environment & Infrastructure, Inc., Novi, Michigan. October 2010, revised June 2012.

AMEC 2010. *Quality Assurance Project Plan*, Tower Automotive Operations USA I, LLC, 81 Drettmann Drive, Elkton, Michigan. AMEC Earth & Environmental, Inc., Brighton, Michigan. October 2010.

CFR 1998. Code of Federal Regulations, Title 40 - Protection of Environment, Part 761 - Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions. June 29, 1998.

USEPA. 1991. Management of Investigation-Derived Wastes During Site Inspection. USEPA 1991.

TABLES

TABLE 1
Summary of Areas of Concern
Remedial Action Work Plan
Tower Automotive Operations USA I, LLC
Elkton, Michigan
AMEC Project #: 7-6797-0010

Area Designation	Proposed Occupancy	Proposed Cleanup Standard (mg/kg)
AOC 1 - Paint Shed Area	PB HO	1
AOC 2 - South Courtyard	SI LO	25
AOC 4 - North Courtyard	PB HO	1
AOC 7/8 - Drainage Ditch Area	PB HO	1
AOC 9 - On-Site Drainage Ditch Sediment	PB HO	ND

Notes:
AOC - Area of Concern
mg/kg - milligrams per kilogram
ND - Not detected
PCBs - Polychlorinated Biphenyls
SI - Self-Implementing Cleanup
PB - Performance-Based Cleanup

LO: Low Occupancy - unprotected individuals may occupy an area with non-porous surfaces containing PCBs for less than 840 hours per year or an area with porous surfaces containing PCBs for less than 335 hours per year

HO: High Occupancy - unprotected individuals may occupy an area with non-porous surfaces containing PCBs for greater than 840 hours per year or an area with porous surfaces containing PCBs for greater than 335 hours per year

Table 2: PCB Sample Summary
Remedial Action Work Plan
Tower Automotive Operations USA I, LLC
Elkton, Michigan
AMEC Project #: 7-6797-0010

	Proposed Cleanup Standard (ppm)	Depth Interval (ft bgs)	Total Number of Samples Analyzed from Depth Interval	Number of Historic Sample Exceedances	Greatest Historic Detection (ppm)	Number of Current Sample Exceedances	Greatest Current Detection (ppm)
AOC 1	1	0-0.5	8	1	6.2	NA	NA
		0-2 & 2-4	4	0	0.7	NA	NA
AOC 2	25	0-0.5	72	6	1,600	1	42.6
		0.5-1	17	NA	NA	0	2.34
		1-1.5	4	1	4,200	0	0.592
		1.5-2	6	NA	NA	0	9.96
		3	1	NA	NA	0	3.6
AOC 4	1	0-0.5	17	4	17.2	2	2.51
		0.5-1	1	NA	NA	1	2.152
		2	1	NA	NA	0	0.691
AOC 7/8	1	0-0.5	1	1	1.2	NA	NA
		1-1.5	50	0	0.84	6	37.705
		1.5-2	7	NA	NA	3	2.856
AOC 9 (Sediments)	non-detect	0-0.5	5	4	5.9	NA	NA
		1-1.5	20	2	55.1	7	4.602
		1.5-2	9	3	34	1	15.43

Notes:
NA: not applicable; no sample collected from depth interval
ppm: parts per million
ft bgs: feet below ground surface
AOC: Area of Concern

Table 3: Excavation Summary
Remedial Action Work Plan
Tower Automotive Operations USA I, LLC
Elkton, Michigan
AMEC Project #: 7-6797-0010

	Expected Excavation Volume (yd^3)	Estimated Number of Confirmatory Samples
AOC 1	1	3
AOC 2	46	32
AOC 4	67	44
AOC 7/8	176	114
AOC 9 (Sediments)	346	26
Total =	**636**	**219**

Notes:
AOC = Area of Concern
ft^2 = square feet
yd^3 = cubic yards

FIGURES

FIGURE 1

Site Location Map

Tower Automotive
81 Drettmann Drive
Elkton, Michigan

Location of Site

Site

Elkton
(BM 647)

Water Tank
WT

Trailer Park

BM 648

Riverside Cem

Pinnebog

O L I V E R

RICHARDSON ROAD

OHIO ROAD

NEFFLE ROAD

GEIGER ROAD

CHESAPEAKE AND

KROHN DRAIN

ELKTON DRAIN

HARTSELL RD

142

0 1,000 2,000 Feet

AMEC Environment & Infrastructure
46850 Magellan Drive, Suite 190
Novi, Michigan 48377
248-926-4008

Coordinate System: UTM Zone 17N meters **Note:** Locations were estimated using CAD drawings and aerial photography.
Data Sources: Environmental Resources Management, ESC Engineering, ESRI StreetMap USA 2005, Michigan Center for Geographic Information, USGS

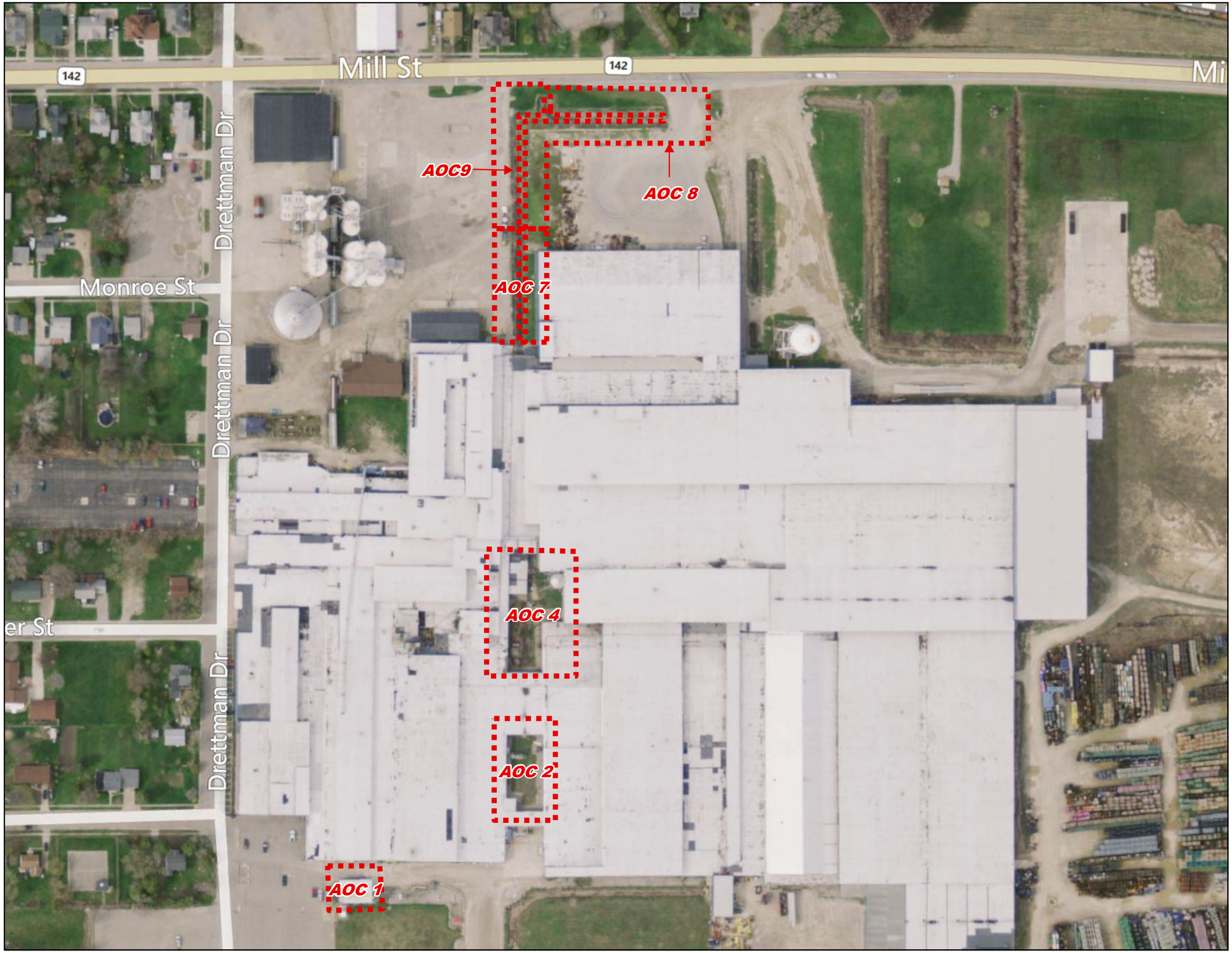

FIGURE 2

Site Layout

Tower Automotive
81 Drettmann Drive
Elkton, Michigan

Location of Site

Area Of Concern

AMEC #7-6797-0009

N

0 75 150 Feet

1 inch = 150 feet

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Novi, Michigan 48377
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amec

B:\Commercial_Industrial\Tower\Elkton\7-6797-0010\GIS\MXD\FIGURE_2.mxd January 31, 2013 DWN: chinmay.kurane CHKD: EAS

Coordinate System: UTM Zone 17N meters **Note:** Locations were estimated using CAD drawings and aerial photography.
Data Sources: Environmental Resources Management, ESC Engineering, ESRI StreetMap USA 2005, Michigan Center for Geographic Information, USGS

FIGURE 3

Drainage Ditch Map

Tower Automotive
81 Drettmann Drive
Elkton, Michigan

Location of Site

Approximate Drainage Ditch Location

- Open
- Enclosed
- Approximate Location of Wiers

AMEC #7-6797-0010

N

0 100 200 Feet

1 inch = 200 feet

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248-926-4008

B:\Commercial_Industrial\Tower\Elkton\7-6797-0010\GIS\MXD\FIGURE_3_DRAINAGE_DITCH.mxd January 31, 2013 DWN: chinmay.kurane CHKD: EAS

Coordinate System: UTM Zone 17N meters **Note:** Locations were estimated using CAD drawings and aerial photography.
Data Sources: Environmental Resources Management, ESC Engineering, ESRI StreetMap USA 2005, Michigan Center for Geographic Information, USGS

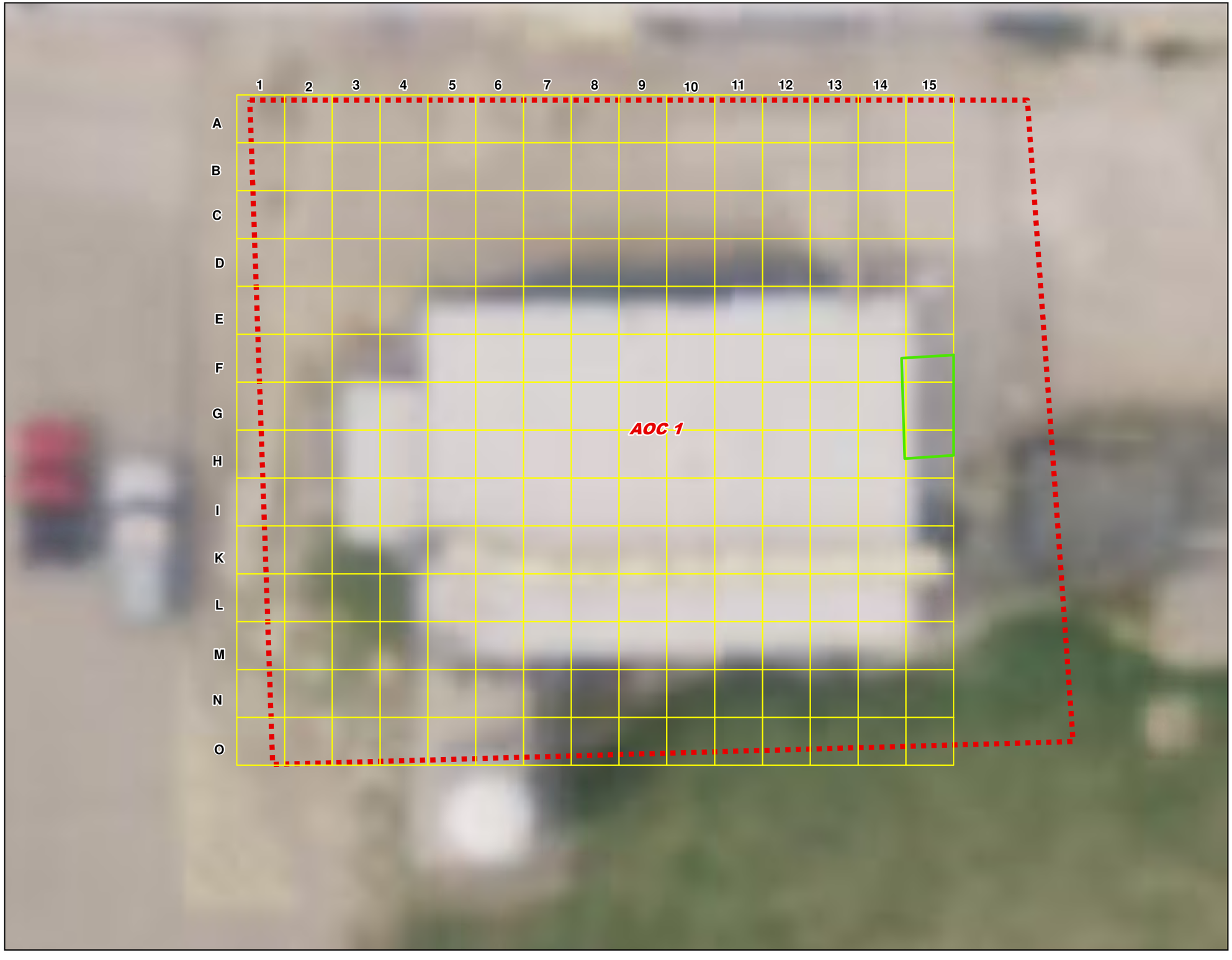

FIGURE 4

AOC 1 Excavation Area

Tower Automotive
81 Drettmann Drive
Elkton, Michigan

Location of Site

AOC1 Excavation Area

Grid 5x5 feet

N

0 5 10 Feet

1 inch = 10 feet

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248-926-4008

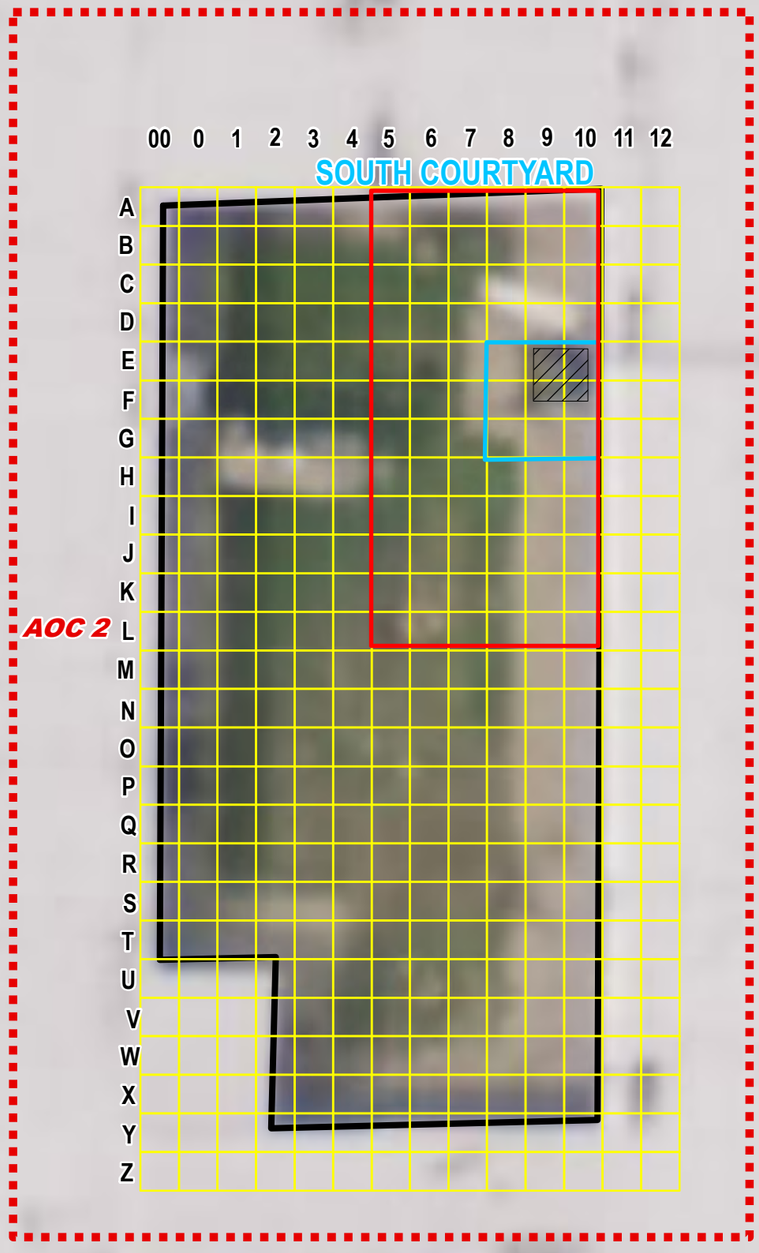
B:\Commercial_Industrial\Tower\Elkton\7-6797-0010\GIS\MXD\FIGURE_4_AOC1_ExcavationArea_01-18-2013.mxd January 28, 2013 DWN: chinmay.kurane CHKD: EAS

Coordinate System: UTM Zone 17N meters **Note:** Locations were estimated using CAD drawings and aerial photography.
Data Sources: Environmental Resources Management, ESC Engineering, ESRI StreetMap USA 2005, Michigan Center for Geographic Information, USGS

FIGURE 5

AOC 2 Excavation Areas

Tower Automotive
81 Drettmann Drive
Elkton, Michigan



Location of Site

Transformer
Grid 5x5 feet
Proposed Excavation Area to 0.5'
Proposed Excavation Area to 2'

AMEC #7-6797-0009

N

0 10 20 Feet

1 inch = 20 feet

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B:\Commercial_Industrial\Tower\Elkton\7-6797-0010\GIS\MXD\FIGURE_5_AOC2ExcavationArea01-16-2013.mxd January 31, 2013 DWN: chinmay.kurane CHKD: EAS

Coordinate System: UTM Zone 17N meters **Note:** Locations were estimated using CAD drawings and aerial photography.
Data Sources: Environmental Resources Management, ESC Engineering, ESRI StreetMap USA 2005, Michigan Center for Geographic Information, USGS

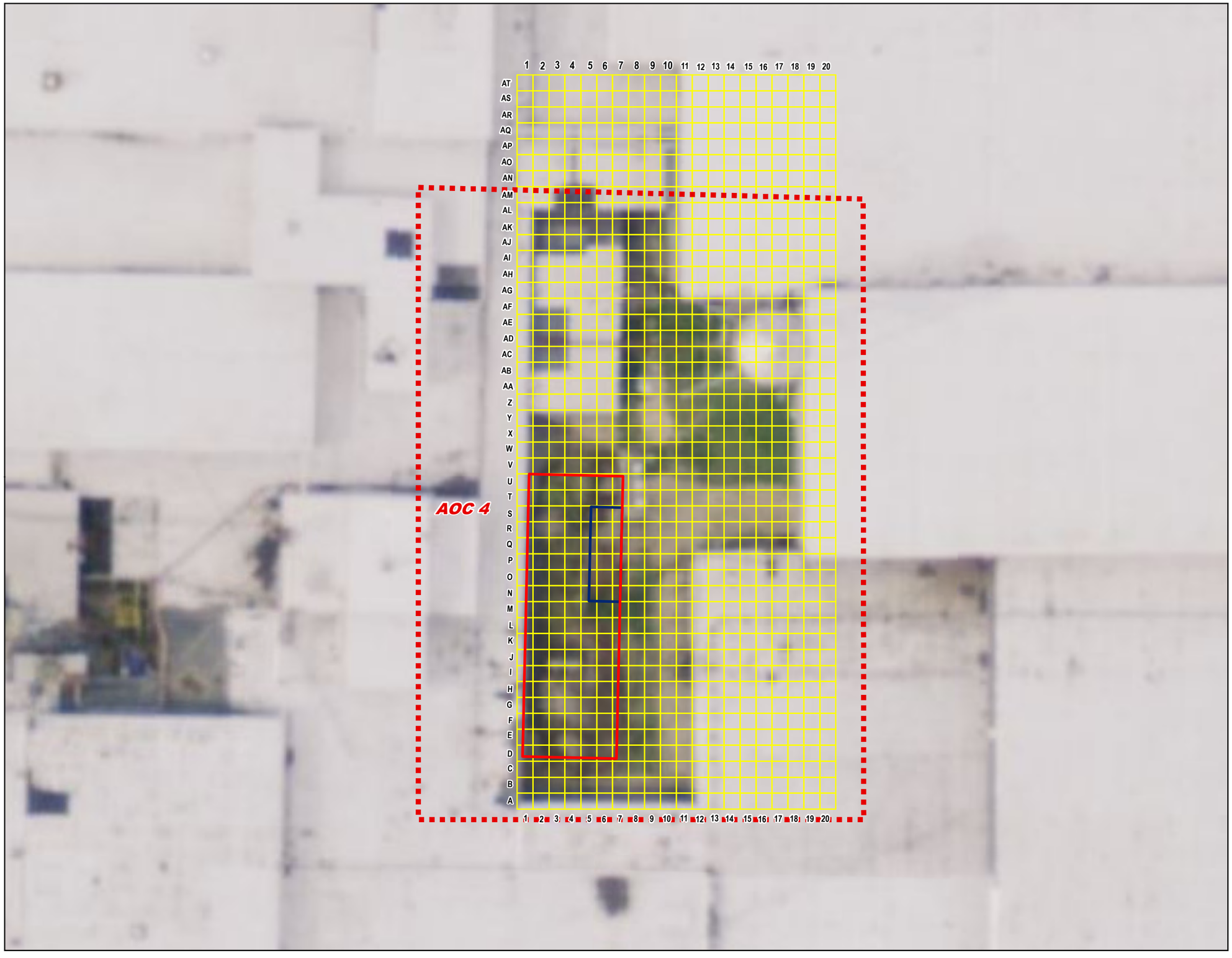

FIGURE 6

AOC 4 Excavation Areas

Tower Automotive
81 Drettmann Drive
Elkton, Michigan

Location of Site

Transformer

Grid 5x5 feet

Proposed Excavation Area to 0.5'

Proposed Excavation Area to 1.5'

AMEC #7-6797-0009

N

0 15 30 Feet

1 inch = 30 feet

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B:\Commercial_Industrial\Tower\Elkton\7-6797-0010\GIS\MXD\FIGURE_6_AOC4ExcavationArea01-16-2013.mxd January 31, 2013 DWN: chinmay.kurane CHKD: EAS

Coordinate System: UTM Zone 17N meters **Note:** Locations were estimated using CAD drawings and aerial photography.
Data Sources: Environmental Resources Management, ESC Engineering, ESRI StreetMap USA 2005, Michigan Center for Geographic Information, USGS

FIGURE 7a
AOCs 7, 8 and 9
Excavation Areas

Tower Automotive
81 Drettmann Drive
Elkton, Michigan

Location of Site

AOC 8

AOC 9

AOC 7

All of AOC9 excavated to 1.5

- Transformer
- Grid 5x5 feet
- Proposed Excavation Area to 1.5'
- Proposed Excavation Area to 2'

AMEC #7-6797-0009

N

0 15 30 Feet

1 inch = 30 feet

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B:\Commercial_Industrial\Tower\Elkton\7-6797-0010\GIS\MXD\FIGURE_7a_AOC789ExcavationArea01-16-2013.mxd January 31, 2013 DWN: chinmay.kurane CHKD: EAS

Coordinate System: UTM Zone 17N meters **Note:** Locations were estimated using CAD drawings and aerial photography.
Data Sources: Environmental Resources Management, ESC Engineering, ESRI StreetMap USA 2005, Michigan Center for Geographic Information, USGS

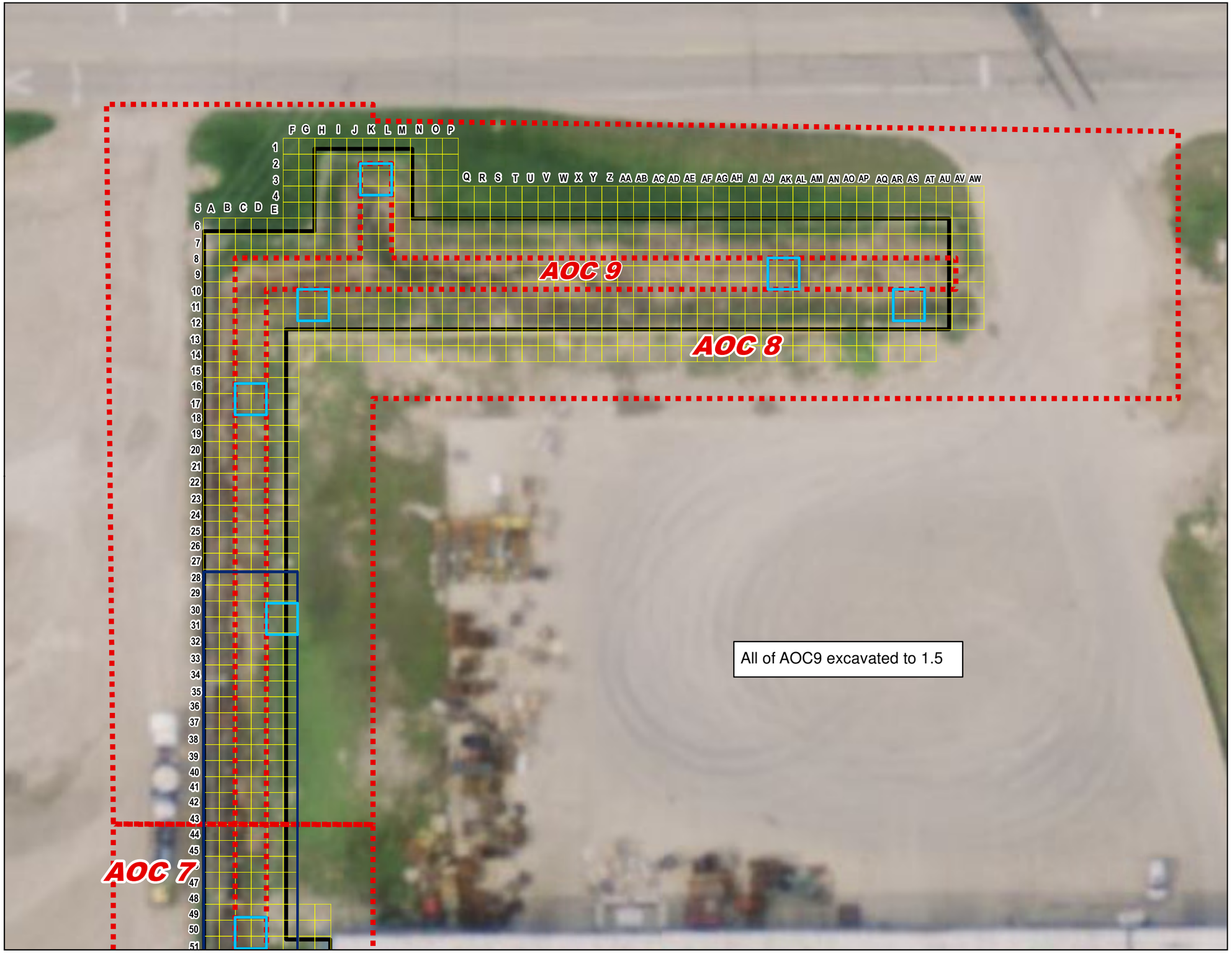

FIGURE 7b
AOCs 7, 8 and 9
Excavation Areas

Tower Automotive
81 Drettmann Drive
Elkton, Michigan

Location of Site

Transformer

Grid 5x5 feet

Proposed Excavation Area to 1.5'

Proposed Excavation Area to 2'

AMEC #7-6797-0009

N

0 15 30 Feet

1 inch = 30 feet

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B:\Commercial_Industrial\Tower\Elkton\7-6797-0010\GIS\MXD\FIGURE_7b_AOC789ExcavationArea01-16-2013.mxd January 31, 2013 DWN: chinmay.kurane CHKD: EAS

Coordinate System: UTM Zone 17N meters **Note:** Locations were estimated using CAD drawings and aerial photography.
Data Sources: Environmental Resources Management, ESC Engineering, ESRI StreetMap USA 2005, Michigan Center for Geographic Information, USGS

APPENDIX A

HEALTH AND SAFETY PLAN

HEALTH AND SAFETY PLAN
TOWER AUTOMOTIVE OPERATIONS USA I, LLC
81 DRETTMANN DRIVE
ELKTON, MICHIGAN

AMEC Project No. 7-6797-0010

Prepared for:

Tower Automotive Operations USA I, LLC

Prepared by:

AMEC Environment & Infrastructure, Inc.
46850 Magellan Drive, Suite 190
Novi, Michigan 48377
January 31, 2013

HEALTH AND SAFETY PLAN APPROVALS

PROJECT MANAGER	Signature	Date 01/31/13
SAFETY OFFICER	Signature	Date 1/31/13

Tower Automotive – Elkton Facility
81 Drettman Road, Elkton, Michigan
Site Health and Safety Plan

General Information

Project Name:	Remedial Activities for the Tower Automotive - Elkton Facility
Location:	Elkton, Michigan
Client	Tower Automotive Operations USA I, LLC.
Plan Prepared By:	Elizabeth Stieber – AMEC Environment & Infrastructure, Inc.
Plan Reviewed By:	Nicole Rottet – AMEC Environment & Infrastructure, Inc.
Plan Approved By:	Cindy Sundquist – AMEC Environment & Infrastructure, Inc.
Project Start Date:	To Be Determined

Emergency Contacts

Ambulance	911
Fire	911
Police	911
Poison Control Center	(800) 222-1222
Hospital	Scheurer Hospital 170 North Caseville Road Pigeon, Michigan 48755 (989) 453-3223
HAZMAT (National Response Center)	(800) 424-8802 or 911
Office Health and Safety Coordinator	Nicole Rottet (248) 313-3696 Cell: Non-responsive
Regional HSE Manager	Cindy Sundquist Non-responsive Cell: Non-responsive
Project Manager	Erin Busby (248) 313-3668 Cell: Non-responsive
Field Manager	To Be Determined
Site Safety Officer	To Be Determined
Tower Automotive Environmental Manager	Ron Henderson Non-responsive
Tower Automotive Elkton Facility Environmental Manager	Jim Bowen Non-responsive

TABLE OF CONTENTS

Attachments

1.0 INTRODUCTION

1.1 Purpose and Policy

On behalf of Tower Automotive Operations USA I, LLC (Tower), AMEC Environment & Infrastructure, Inc. (AMEC) has prepared this Health and Safety Plan (HASP) for the Tower Automotive facility located at 81 Drettmann Drive, Village of Elkton, Huron County, Michigan (Site). The purpose of this HASP is to outline the potential health and safety hazards and corresponding protective controls for the planned polychlorinated biphenyl (PCB) remediation activities to be conducted at the Site.

Compliance with this HASP is required for persons and third parties who will be conducting work at the Site as part of the PCB remediation activities. Requirements and guidelines presented in this HASP do not apply to Tower employees or manufacturing operations at the facility. Assistance in implementing this HASP can be obtained from the Site Safety Officer (SSO) and/or the Project Manager (PM). The content of this HASP may change or undergo revision based upon additional information made available to health and safety (H&S) personnel, monitoring results or changes in the scope of work. Any changes proposed must be reviewed by H&S staff and are subject to approval by the SSO and PM.

The health and safety guidelines in this HASP were prepared specifically for the Site and encompass known hazards. If additional hazards are encountered, the level of personal protection will be evaluated and the HASP will be modified as necessary. Neither this HASP nor any part of it should be used on any other site.

1.2 Applicability

This HASP presents requirements and guidelines for work to be completed at the Site as outlined in the PCB Remediation Work Plan (WP). It is in compliance with applicable sections of 29 Code of Federal Regulations (CFR) 1910.120 and 1926.65, Hazardous Waste Operations and Emergency Response (HAZWOPER).

1.2.1 Order of Precedence

Occasionally, procedural conflicts may arise from different documents. The requirement most protective of workers health and safety, the public, and property shall take precedence.

1.2.2 Subcontractor's Responsibilities

Subcontractors shall be solely responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with its work. Subcontractors shall give all notices and comply with all applicable laws, ordinances, rules, regulations, and lawful orders of any public authority bearing on the safety of persons or property, subcontractors shall act to prevent threatened damage, injury or loss.

1.3 Site Location

The Tower Automotive Elkton facility is located at 81 Drettmann Drive in Elkton, Huron County, Michigan. Tower Automotive is the only occupant of the building located on the property. The main manufacturing building's footprint is approximately 1,030,000 feet squared (ft2) and houses office space as well as all manufacturing operations that occur on-site.

1.4 Site Background

Manufacturing operations began at the Site in approximately 1945. Active Tool and Manufacturing Co, Inc. operated the facility from approximately 1945 until 1999 at which time Tower Automotive, Inc. acquired the Site. Tower purchased the facility and operations out of bankruptcy from Tower Automotive, Inc. on July 31, 2007.

Historical operations at the Site have resulted in several releases and subsequent subsurface impacts. Investigations have been conducted at the Site from 1989 to 2004. The investigations were performed to characterize and define impacts to soil, groundwater and/or sediment across the Site.

Investigations identified eight areas of concern (AOCs) that require corrective action since PCBs were detected in soil and/or sediment above applicable cleanup criteria.

1.5 Scope of Work

The primary objective of the remedial activities will be to remove the PCB contaminated soil and/or sediment. In conjunction with the soil removal, sections of the storm sewer will be converted from an open ditch to an enclosed drain or the existing enclosed drain will be replaced. Remedial activities will be completed for the following six AOCs:

- AOC 1 – Paint Shed Area
- AOC 2 – South Courtyard
- AOC 4 – North Courtyard
- AOC 7 – Weir Area
- AOC 8 – Drainage Ditch Area
- AOC 9 – Drainage Ditch Sediment

Subcontractors will be qualified to perform excavation activities, piping installation, and private utility locating services. Subcontractors will be responsible for ensuring compliance with this HASP and with their company specific HASP, among its employees during the field work.

1.6 Health and Safety Planning

The Field Manager will identify the work area, task to be performed, and will lead the crew in performing task hazard assessment evaluation. The hazard assessment is specific to the work to be performed and requires the Field Manager to solicit crew participation in identifying

hazards and hazard control measures such as personal protective equipment (PPE), training requirements, permits, procedures, etc.

1.7 Project Organization and Responsibilities

Regional Health, Safety, and Environment Manager (Regional HSE Manager). The Regional HSE Manager is responsible for the approval of the HASP and coordinating the implementation of health and safety procedures with the Field Manager. In addition, the Regional HSE Manager is responsible for approval of all changes made to this HASP.

Field Manager (FM) / Site Safety Officer (SSO). The FM / SSO is responsible for the implementation of the HASP during field activities, including correcting recognized unsafe acts or conditions, enforcing health and safety procedures, and conducting tailgate meetings. The SSO is responsible for establishing evacuation routes and assembly areas and has the authority to stop all work if conditions are judged to be dangerous to on-site personnel or the public. In addition, the SSO is responsible for reporting and investigating near misses and accidents.

Technical Staff. AMEC and subcontracting personnel are responsible for compliance with this HASP in its entirety. They are responsible for taking reasonable precautions to prevent injury to themselves and to their fellow employees and for being on the alert for potentially harmful situations. Technical staff is expected to perform only those tasks that they believe can be performed safely and to immediately report any accidents, near misses, and/or unsafe conditions to the FM /SSO. They are also responsible for notifying the FM /SSO of any special medical conditions (e.g., allergies, diabetes, etc.).

Subcontractors. Subcontractors are responsible for the conduct of personnel while on-site, ensuring their compliance with this HASP, and notifying the FM /SSO of any special medical conditions (e.g., allergies, diabetes, etc.). Subcontractors are also responsible for correcting any unsafe acts/conditions identified by the FM / SSO.

2.0 SAFETY AND HEALTH RISK ANALYSIS

2.1 Chemical Hazard Analysis

PCBs have been previously detected in site soil and sediment at concentrations exceeding regulatory criteria. Toxicity assessment data for PCBs are summarized in **Table 2-1**. A toxic substance fact sheet for PCBs is provided in **Attachment A**.

TABLE 2-1. TOXICITY ASSESSMENT

Contaminant	IDLH LEVEL	PEL/TLV	Acute Toxicological Symptoms for Relevant Exposure Pathway (oral, dermal, inhalation)
PCBs	Carcinogen (5 mg/m^3)	TWA 0.5 mg/m^3	Exposure to high amounts of PCBs can cause skin conditions such as acne and rashes. Studies have shown that PCB exposure may cause liver damage and cancer of the liver and biliary tract.

2.2 Physical Hazards

Work sites may contain slip, trip, and fall hazards for site workers, such as:

- Holes, pits, or ditches;
- Slippery surfaces;
- Steep grades;
- Uneven grades;
- Sharp objects, such as nails, metal shards, and broken glass;
- Weather conditions that make surfaces slippery and obscure visibility; and
- Surrounding animal, insect, and plant life.

2.2.1 Operation In and Around and Operating Facility

Potential hazards include:

- Slips/trips/fall
- Falling objects
- Struck by heavy equipment
- Overhead/underground utilities

Prevention

- Complete any required facility training prior to beginning work on-site
- Ensure Facility operators are aware of the construction work area
- Be aware of all process lines and utilities
- Wear proper PPE

- Be aware of surroundings, especially movement of heavy equipment and suspended loads
- Ensure equipment operators area aware of your location
- Be aware of overhead and underground utilities

2.2.2 Construction Hazards and Heavy Equipment

Construction activities include: soil excavation, loading, transportation, and disposal, concrete cutting and removal, backfill and compaction, and installation of a sewer pipe. Potential equipment used include: excavator, backhoe, loader, skidsteer, roller, and walk behind compactor. Potential hazards include:

- Slips/trips/fall
- Falling objects
- Struck by heavy equipment
- Overhead/underground utilities
- Chemical exposure

Prevention

- Communicate with all on-site workers prior to the start of each task and discuss possible hazards
- Wear proper PPE
- Be aware of surroundings, especially movement of heavy equipment and suspended loads
- Ensure equipment operators area aware of you location
- Be aware of overhead and underground utilities
- Avoid direct contact with contaminated material

2.2.3 Noise Hazards

Planned activities such as excavation and concrete removal may involve the use of noise producing equipment. The unprotected exposure of site workers to this noise during activities could result in noise-induced hearing loss.

Prevention

Hearing protection such as ear plugs or ear muffs is required during the operation of noise producing equipment.

2.2.4 Explosions

AMEC does not anticipate the presence of explosive atmospheres during this work.

2.2.5 Oxygen Deficient Atmosphere

AMEC does not anticipate the presence of oxygen deficient atmospheres during this work.

2.2.6 Heat/Cold Related Stress/Illness and Prevention

Heat

There is a potential for heat stress and related injuries during this period, especially when heavy manual labor-intensive activities are performed with semi-permeable and impermeable PPE. Potential hazards include:

- Heat rash
- Heat cramps
- Fainting
- Heat exhaustion
- Heat stroke

Prevention

- Workers are trained to recognize the symptoms of heat-related injuries and illnesses;
- Heat-related injury and illness recognition and prevention measures will be emphasized during daily safety tailgate meetings when the potential for such injuries and illnesses exists; and
- Cool beverages will be available on-site. Workers will be encouraged to drink fluids.

Cold

Exposure to low temperatures presents a risk to employee safety and health both through the direct effect of the low temperature on the body and collateral effects such as slipping on ice, decreased dexterity, and reduced dependability of equipment. Specific potential hazards include:

- Frostbite
- Chill blains
- Hypothermia

Prevention

- Workers are trained to recognize the symptoms of frostbite and hypothermia.
- Cold injuries and illnesses recognition and prevention measures will be emphasized during daily safety tailgate meetings when the potential for cold injuries and illnesses exists.
- Work will cease under unusually hazardous conditions.
- Phenothiazine (a sedative) and beta blocker drug use will be prohibited.
- Heated vehicles will be available on-site.
- Insulating dry clothes will be available.
- Temperature will be recorded on-site.
- Warm beverages will be available on-site.

3.0 PERSONNEL PROTECTION AND MONITORING

3.1 Medical Surveillance

Periodic Comprehensive Exam:
Personnel requiring access to controlled work areas will have a baseline medical examination and a periodic (usually annual) update examination prior to assignment, in accordance with Occupational Safety and Health Administration (OSHA) 29 CFR 1910.120(f). The exam must be performed by an Occupational Health Physician, who will provide written clearance for hazardous waste site work and respirator usage. Protocols for the baseline, periodic, and exit exams must be at least as stringent as those defined in the AMEC Medical Surveillance Program, Volume III of AMEC's Corporate Health and Safety Manual (CHSM).

Emergency Medical Treatment:
In the event that a worker requires transportation to a hospital, the routes to the hospital are located in **Attachment B**. The identified hospital facility is Scheurer Hospital in Pigeon, Michigan. The Contingency Plan Section (Section 4.8) of this HASP outlines additional information regarding emergency services and logs, reports, and record keeping. Subcontractors should have Workers' Compensation information available for emergency use.

Medical Clearance Record Keeping:
Medical clearance documents are on file at the employee's home office. To ensure confidentiality, results of the medical exams or treatment records are maintained at the Medical Care Provider's clinical offices.

3.2 Site-Specific Training

Routine on-site general site workers performing intrusive activities or having potential to receive exposures exceeding permissible limits will have completed the OSHA 40-hour Hazardous Waste Operations Training. Appropriate annual refresher (within 12 months) updates must be completed by all HAZWOPER personnel. Supervisors will have completed the above and an additional 8 hours of OSHA Supervisory Training.

Occasional site workers that are not expected to receive exposures exceeding permissible exposure limits (e.g., geophysical and land surveyors) require only 24 hours of OSHA Hazardous Waste Operations Training.

3.3 Personal Protective Equipment and Action Levels

The purpose of personal protective clothing and equipment is to shield or isolate individuals from the hazards that may be encountered when engineering and other controls are not feasible or cannot provide adequate protection. Adherence to all prescribed controls is vital to minimize exposures.

PPE will be provided and utilized based upon the tasks. PPE may be upgraded or downgraded and documented by the SSO based upon site conditions and air monitoring results. Minimum PPE requirements for this project are presented in **Table 3-1**.

Site work tasks are listed below. Task-specific Hazard Analysis forms are provided in **Attachment C**.

1. Construction Oversight
2. Excavation and Trenching
3. Working Near Overhead Utilities
4. Heavy Equipment Operation
5. Loading/Transportation of Soil
6. Soil Boring Completion via Geoprobe™/Direct Push Rig
7. Soil/Sediment Sample Collection
8. Borehole Abandonment
9. Sewer Survey
10. Handling and Sampling Investigation-Derived Waste

TABLE 3-1. MINIMUM PERSONAL PROTECTIVE EQUIPMENT (PPE) REQUIREMENTS

TASK No.	LEVEL OF PPE	Personal Protective Equipment						
		VISUAL	GLOVES	FEET	HEAD	EYE	EAR	RESPIRATOR
1 - 10	D	High Visibility Vest	Leather work gloves, nitrile gloves as needed	Steel-toed boots	Hard hat	Safety glasses	Ear plugs or ear muffs (> 85dbA) as needed	NA

3.4 Monitoring Requirements

3.4.1 Routine Air Monitoring for Organic Vapors

Volatile organic compounds (VOCs) may be introduced into the work zone by the collection of soil, sediment, or groundwater impacted with petroleum constituents, or exhaust produced from construction equipment. The SSO or designee will conduct the initial contaminant source monitoring and breathing zone monitoring for VOCs using an 11.7 eV photoionization detector (PID). PID readings will be logged in the field notebook. The PID shall be calibrated in accordance with manufacturing requirements, e.g., at least daily, and results of the calibration shall be documented in the field notebook. PCBs have low volatility and the vapors are not expected to be in the breathing zone in concentrations approaching the exposure limit based on the type of work being conducted at the Site. Breathing zone contaminant action levels for VOCs are specified in **Table 3-2**.

3.4.2 Routine Air Monitoring for Dust

Possible exposure routes for PCBs include the inhalation of PCB-impacted dust. Although construction activities in general have the potential to produce fugitive dust, site conditions (i.e. excavation of soil/sediment within drainage ditches) will limit the fugitive dust potential. The SSO will observe for the generation of dust and monitor with a hand held dust monitor during construction activities. If airborne particulates are observed or the dust monitor records sustained reading above the action level, work will cease until dust suppression is implemented.

TABLE 3-2. MONITORING PROTOCOLS AND CONTAMINANT ACTION LEVELS

CONTAMINANT/ ATMOSPHERIC CONDITION	MONITORING EQUIPMENT	MONITORING PROTOCOL	BREATHING ZONE[1] ACTION LEVEL CONCENTRATIONS[2]	
			MONITORED LEVEL FOR MANDATORY RESPIRATOR USE[3]	MONITORED LEVEL FOR MANDATORY WORK STOPPAGES[3]
Organic compounds	PID	Every 15 – 30 minutes during intrusive work activities	Sustained readings above background levels	Sustained readings above background levels
Dust/PCBs	Dust Monitor	Every 15 – 30 minutes during intrusive work activities	≥ 1.5 mg/m^3	≥ 15 mg/m^3

1 Monitoring performed at operator's breathing zone. Monitor at the source first; if the source concentration is near or above the action level concentration, monitor in the breathing zone.
2 PID readings are recorded as above site atmosphere background levels.
3 Call the Project Manager and Health and Safety Manager for consultation.

Furthermore, the results of future soil and groundwater sample analysis will be incorporated into the monitoring program as data becomes available. If any chemical analysis is performed as part of site assessment activities, then that data will also be utilized to update the HASP.

3.4.3 Routine Monitoring for Explosive Environments

None anticipated.

3.4.4 Oxygen Monitoring

None anticipated.

3.4.5 Monitoring for Heat/Cold -Related Stress/Illnesses

Using the buddy system, team members will be responsible for observing their buddy for any signs of heat-related stress, cold exposure, or illness. It is also the responsible of individual employees to minimize overexertion by taking frequent breaks; work during cooler or warmer hours; drink plenty of fluids (2 gallons of water during an 8-hour shift); and wear cotton or thermal clothing when appropriate.

3.5 Background Readings

None anticipated.

3.6 Data Logging

None anticipated.

3.7 Dust Control

Dust suppression (i.e. water) will be used as necessary during concrete cutting and excavation activities.

4.0 SITE CONTROL, MEASURES, ACCIDENT PREVENTION, AND CONTINGENCY PLAN

4.1 Site Control Measures

The Site control currently anticipated involves site security (Section 4.6), and communications (Section 4.7). Work zones that will be utilized during field activities are discussed in Section 4.2.

4.2 Work Zones

The work zones established for this field effort are as follows:

- Exclusion Zone (EZ)
- Contamination Reduction Zone (CRZ)
- Support Zone (SZ)

4.2.1 Exclusion Zone

The EZ is defined as an area with an approximately 10-foot radius around intrusive activities. Access is restricted to construction crews and necessary equipment operators.

4.2.2 Contamination Reduction Zone

As necessary, two separate decontamination lines shall be established for personnel and sampling equipment in the CRZ. The CRZ is a narrow area through which personnel and equipment pass from the EZ to the SZ.

4.2.3 Support Zone

The SZ will be upwind or crosswind and away from the contaminated area. Vehicles, emergency equipment, telephone and break area, and any non-essential personnel will be maintained in this area.

4.3 Safe Work Practices

- Unauthorized personnel are not allowed on-site, particularly in the EZ.
- Work groups will always consist of at least two team members.
- A high standard of personal hygiene will be observed. Smoking, eating, drinking, chewing gum or tobacco, taking medication, and applying cosmetics will not be permitted within any restricted area or EZ.
- Personnel under the obvious influence of alcohol or controlled substances are not allowed on-site; those taking medications must notify the SSO.
- Site personnel will familiarize themselves with these practices and the emergency procedures during daily tailgate and pre-work safety meetings.
- Workers who are passengers or drivers of vehicles (both off-site and on-site) will wear their seat belts any time the vehicle is in motion.

- Personnel will avoid skin contact with contaminated or potentially contaminated media. If such contact occurs, the affected areas should be washed thoroughly with soap and water.
- Personnel will discard and replace any damaged or heavily soiled protective clothing. Discarded PPE will be containerized or drummed at the end of each day.
- Personnel should notify the SSO of any defective monitoring, emergency, or other protective/safety equipment.
- A supply of potable water, electrolyte replacement solutions, shaded break area, and sufficient lighting will be maintained on-site; and sanitary facilities will be accessible to personnel.

4.4 Health and Safety Equipment Checklist

- Open flames are not allowed anywhere on-site without a hot-work permit.
- Owners/operators of heavy equipment will ensure that the equipment is in good working order by performing daily inspections and routine maintenance. Deficiencies affecting health and safety shall be corrected prior to equipment use.
- Unsafe conditions shall be made safe immediately. Unsafe conditions shall be reported to the Project Manager and the condition corrected.
- Loose-fitting clothing or loose long hair are prohibited near moving machinery
- Internal combustion engines must have spark arrestors that meet the requirements for hazardous atmospheres, if they are to be used in such areas.
- Do not fuel engines while vehicle is running.
- Install adequate on-site roads, signs, lights, and devices.
- When portable electric tools and appliances can be used (where there is no potential for flammable or explosive conditions), they will be equipped only with 3-wire grounded power and extension cords to prevent electrical shock.
- Store tools in clean, secure areas so they will not be damaged, lost, or stolen.
- When exiting a vehicle, shift into park, set the parking brake, and shut off the engine. Never leave a running vehicle unattended.

4.5 Accident Prevention

The SSO as well as site employees will inspect the work site daily to identify and correct unsafe conditions.

Adherence to the Safe Work Practices (to follow) and procedures outlined in this HASP will assist with accident prevention. Job Safety Analysis/Hazard Analysis (JSA/HA) forms are included in **Attachment C.**

4.5.1 Heavy Equipment Operation

Working with large motor vehicles and heavy equipment could be a major hazard at the Site. Injuries can result from equipment hitting or running over personnel, impacts from flying objects, or overturning of vehicles. Vehicle and heavy equipment design and operation will be in accordance with 29 CFR, Subpart O, 1926.602. In particular, the following precautions will be utilized to help prevent injuries/accidents.

- Brakes, hydraulic lines, light signals, fire extinguisher, fluid levels, steering, tires, horn, and other safety devices will be checked at the beginning of each shift.
- Large construction motor vehicles will not be backed up unless:
    1. The vehicle has a reverse signal alarm audible above the surrounding noise level; or
    2. The vehicle is backed up only when an observer signals that it is safe to do so.
- Heavy equipment or motor vehicles cable will be kept free of nonessential items, and loose items will be secured.
- Large construction motor vehicles and heavy equipment will be provided with necessary safety equipment (seat belts, roll-over protection, emergency shut-off in case of roll-over, backup warning lights and audible alarms.)
- Blades and buckets will be lowered to the ground and parking brakes will be set before shutting off heavy equipment or vehicles.

4.5.2 Underground Utility Clearance

Prior to conducting subsurface investigation activities, underground utility locations will be marked and cleared in the work zones. Utility marks will be made using information provided by MISS DIG, Michigan's one-call system, a geophysical survey conducted by a private utility locate subcontractor (if borings or excavations will extend beyond 2 feet below the ground surface), and facility personnel.

4.5.3 Excavation Activities

Underground utilities will be located prior to conducting excavation activities. Hard hats, safety glasses, and safety boots must, as a minimum, be worn within 50 feet of the excavator or other heavy equipment. The FM/SSO or his/her designee will provide constant on-site supervision of the excavation subcontractor to document that they are meeting the health and safety requirements. If deficiencies are noted, work will be stopped and corrective action will be taken (e.g., retrain, purchase additional safety equipment, etc). Reports of health and safety deficiencies and the corrective action taken will be forwarded to the PM.

4.6 Site Security

Access will be limited to controlled areas via the prescribed administrative (certifications) controls. Site personnel and visitors will note arrival and departure times in the site logbook. Equipment, tools, and property shall be secured at the end of each day.

4.6.1 Visitor Access

Site visitors (except OSHA inspectors) must receive prior approval from the PM and Tower, and may do so only for the purposes of observing site conditions or operations. Upon arrival, visitors will report to the SSO. Visitors, regardless of their rank or professional level, will not be allowed into controlled work areas unless training and medical requirements have been met and documented.

4.7 Communications

The "buddy system" will be enforced for any work within the EZ, when appropriate. Each person will observe his/her buddy for symptoms of chemical or heat overexposure and will provide first aid or emergency assistance when warranted. A buddy pair may be comprised of AMEC personnel, subcontractor, personnel, or a combination thereof. In some circumstances, such as O&M activities, only one individual will be working on-site. In these situations, the individual will be responsible for avoiding exposure to hazardous site conditions. Additionally, a mobile phone will be maintained on-site for emergency use at all times.

The following emergency hand signals will be used:

Thumbs up	=	OK; understand
Thumbs down	=	No; negative
Grasping buddy's wrist	=	Leave Site now
Hands on top of head	=	Need assistance
Horn - one long blast	=	Evacuate Site
Horn - two short blasts	=	All clear, return to Site

4.8 Contingency Plan

4.8.1 Chemical Exposure

If a member of the field crew demonstrates symptoms of chemical exposure the procedures outlined below will be followed:

- Another team member (buddy) will remove the individual from the immediate area of contamination, if safe to do so. The buddy will communicate to the field team (via voice and hand signals) of the chemical exposure. The FM/SSO will contact appropriate emergency repose agency.
- Precautions will be taken to avoid exposure of other individuals to the chemical.
- If the chemical is on the individual's clothing, the chemical will be neutralized or removed if it is safe to do so.
- If the chemical has contacted the skin, the skin will be washed with copious amounts of water.
- In case of eye contact, an emergency eye wash will be used. Eyes will be washed for at least 15 minutes.

- All chemical exposure incidents must be reported in writing to the Regional HSE Manager. The FM/SSO is responsible for completing the accident report (See **Attachment D**).

4.8.2 Personal Injury

In the event of a work related injury or illness during normal working hours which requires either first aid or outside medical treatment to an employee, the following steps are to be taken:

- If the injury or illness requires first aid treatment only, the injured employee should immediately contact their immediate supervisor and Regional HSE Manager and have first aid administered as required. First aid supplies are available in each vehicle and offices and qualified designated personnel have been identified to assist with this effort.
- If an injured person requires the services of outside medical services, such as paramedics, immediately contact 911 by cell phone.

4.8.3 AMEC Early Injury Case Management Program

If the emergency involves an injury to an AMEC employee, the HSE Coordinator or Field Lead are to implement the AMEC Early Injury Case Management program. See procedures below:

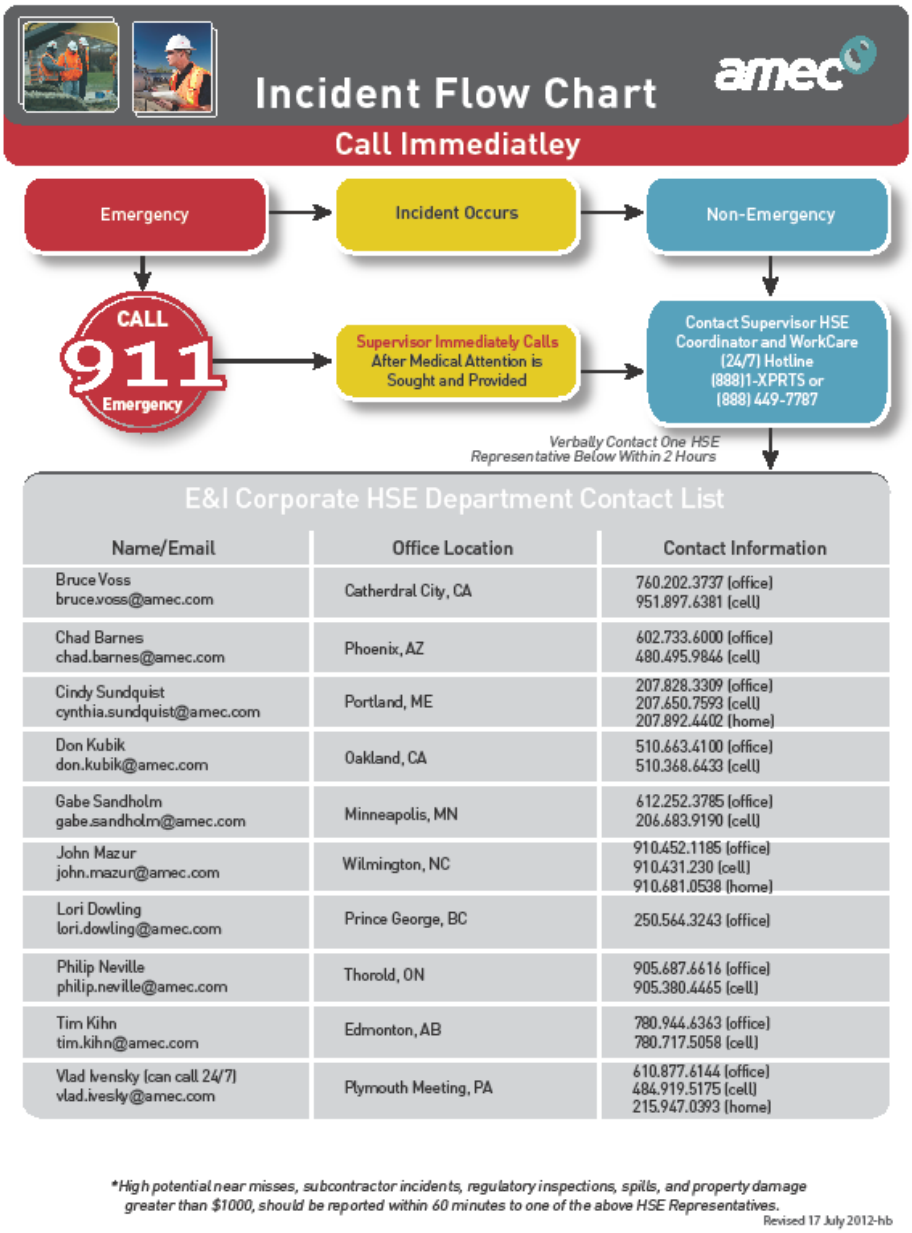
NON-EMERGENCY INCIDENT	EMERGENCY INCIDENT
Steps 1 & 2 must be completed before seeking medical attention other then local first aid. 1. Provide first-aid as necessary. Report the situation to your immediate supervisor AND HSE coordinator (all incidents with the apparent starting event should be reported within 1 hour of occurrence). 2. Injured employee must:	1. Provide emergency first aid. Supervisor on duty must immediately call 911 or local emergency number; no employee may respond to outside queries without prior authorization. Any outside media calls concerning this incident must be referred immediately to Lauren Gallagher at 602-757-3211. 2. Once medical attention is sought and provided, the supervisor must:
Call WorkCare 24/7 Hotline* (888) II-XPRTS or (888) 449-7787	
WorkCare will assess the situation and determine whether the incident requires further medical attention. During this process, WorkCare will perform the following: • Explain the process to the caller. • Determine the nature of the concern. • Provide appropriate medical advice to the caller. • Determine appropriate path forward with the caller. • Maintain appropriate medical confidentiality. • Help caller to execute path forward, including referral to the appropriate local medical facility.	WorkCare will be responsible for performing the following: • Contact the treating physician. • Request copies of all medical records from clinic. • Send an email update to the Corporate HSE Department.

• Send an email notification to the Corporate HSE Department.	

3. IMMEDIATELY after contacting WorkCare send a brief email notification AND inform verbally (direct contact is required) ONE of HSE corporate representatives See Figure 11.3.
4. Make all other local notifications and client notifications.
5. Local Supervisor, HSE Coordinator, SSHO and any applicable safety committees to complete preliminary investigation, along with the initial Incident Report within 24 hours.
6. Corporate Loss Prevention Manager to complete Worker's Compensation Insurance notifications as needed.
7. Corporate HSE to conduct further incident notifications, investigation, include in statistics, classify, and develop lessons learned materials.

* - **NOTE: Step 2 is only applicable to the North-American operations and to incidents involving AMEC personnel. High potential near misses, subcontractors' incidents, regulatory inspections, spills and property damages above $1,000 should be reported immediately, following directions from Step 3.**

FIGURE 11.3
INCIDENT FLOW CHART



4.8.4 Evacuation Procedures

Expeditious evacuation routes to the safe refuge area(s) will be established daily for work area locations, with respect to the wind direction. Evacuation notification will be a continuous blast

on a canned siren, vehicle horn, or direct verbal communication. Emergency drills should be performed periodically. Any additions to evacuation procedures require an update to this HASP.

In the unlikely event that an evacuation is necessary, personnel will immediately proceed to the predetermined safe refuge area, decontaminating to the extent possible for personal safety, based on the emergency.

4.9 Decontamination procedures

Procedures for the decontamination of sampling tools and other related equipment are specified in the Work Plan. Note that separate areas should be established for personnel and sampling equipment.

4.9.1 Decontamination-Medical Emergencies

In an emergency, the primary concern is to prevent the loss of life or severe injury. If immediate medical attention is required to save a life, decontamination should be delayed until the victim is stabilized. If the decontamination can be performed without interfering with essential life-saving techniques or first aid, or if a worker has been contaminated with an extremely toxic or corrosive material that could cause severe illness or loss of life, decontamination must be performed immediately. If an emergency due to a heat-related illness develops, protective equipment should be removed carefully from the victim as soon as possible. See **Attachment B** for a map to the nearest hospital.

Any time emergency decontamination methods must be used, an Incident Report or Supervisor's Report of Injury or Illness must be completed by the SSO and submitted to the Regional HSE Manager.

4.9.2 Equipment Decontamination

Non-dedicated sampling equipment will be cleaned prior to and between each use. The decontamination procedure will be as follows:

- Wash and scrub with detergent (laboratory grade)
- Rinse with tap water
- Rinse with distilled water
- Air dry
- Wrap in aluminum foil (as needed)

All decontamination fluids will be containerized and handled as specified in the WP.

4.10 Personal Decontamination

Disposable gloves will be used for sample handling and will be removed and disposed of following use. No other decontamination procedures will be necessary.

4.11 Places of Refuge

This will be discussed in the tailgate meetings by the FM/SSO daily, once on-site. It will be set up in the SZ or at an off-site location in the event of a site-wide evacuation. This area will be upwind, and the location and escape routes will be designated on-site control maps. It will contain emergency equipment, escape route maps, communications, and the emergency reference (call) list. This is required for all phases of work. In an emergency, the FM/SSO will take a "head count" against the site personnel listed in the site log book, initiate search/account for missing persons, notify the emergency crews (as applicable), and limit access into the hazardous emergency area to necessary rescue and response personnel in order to prevent additional injuries and possible exposures.

4.12 Fire

Fires and explosion are not anticipated. However in the event of a fire or explosion, the emergency alarm will sound (continuous blast on a canned siren, vehicle horn, or direct oral communication) to summon the SSO, who will then decide whether to call the fire department for outside assistance. Small-scale fires (less than one-half of the responder's height) should be extinguished with an accessible ABC fire extinguisher by any team member who has received training. Trained emergency crews will be summoned to control any large-scale or potentially unmanageable incident. Off-site responding agencies will be given a site map and briefed about site-specific hazards so they can be optimally helpful in an emergency situation. The SSO will evacuate all non-response personnel and visitors to the safe refuge area; will notify the AMEC PM, the client, and the Regional HSE Manager; and will complete the appropriate reports.

4.13 Safety Eyewash

Field crews are required to carry an eyewash/eye care kit.

4.14 Incident Report

The SSO will contact the Regional HSE Manager and conduct an investigation jointly with the PM. The Incident Analysis Report (IAR) form will be competed (**Attachment D**). These completed reports must be transmitted to the AMEC Regional HSE Manager within 24 hours of an occurrence; a fax is acceptable. The Regional HSE Manager will submit the appropriate reports to the Corporate Vice President of HSE and the Risk Manager.

In case of environmental incidents, property damage, power disruption, or mandated work "shutdowns," an Incident Report will be prepared by the PM. Any damage, loss, or theft of AMEC property (items/tools/equipment) will be reported to the PM and an IAR completed

Any release of information in these reports to unauthorized persons or agencies is prohibited unless it is first approved by the client. Certain agencies or persons, such as OSHA or OSHA inspectors, can request this information and the release will be permitted. Review the emergency call list for additional contact names and phone numbers.

4.15 Operation Shutdown

If an operation shutdown is necessary, the steps below shall be followed:

- Personnel are to leave the work location (upwind) and assemble at a designated assembly point (if safe) after detecting the emergency signal for evacuation;
- If an emergency situation is of concern to local site personnel, personnel will notify the SSO who will notify the appropriate individuals.
- If appropriate and safe, the SSO and a "buddy" are to remain at or near the location after the location has been evacuated to assist local responders and advise them of the nature and location of the incident;
- The FM/SSO is to account for field team members at the assembly point; and
- The FM/SSO is to complete an incident report (**Attachment D**) as soon as possible after the occurrence.

Evacuation routes and assembly points will be documented by the FM/SSO during the employee health and safety briefing and daily tailgate meetings. Such locations shall minimize the spread of contamination.

4.16 Spill or Hazardous Materials Release

In the event of a spill or release, notify the SSO and Site Manager immediately. The FM/SSO will be responsible for ensuring that necessary notifications are provided to the appropriate individuals.

4.17 Training and Medical Surveillance

4.17.1 Site-Specific Training

Visitor Training

If an official visitor seeks entry into the exclusion zone, the SSO shall verify that the visitor has received health and safety training in accordance with 1910.120 and a medical surveillance examination, and has certification equivalent to that required for on-site work. In addition, a site-specific safety briefing shall be given by the SSO.

Training Documentation

Documentation of training requirements is the responsibility of each employer. Written documentation verifying compliance with 29 CFR 191.120 (e)(3), (e)(4) (as applicable) and (e)(8) must be submitted to the SSO prior to entering the exclusion zone. Documentation of worker's current training credentials will be kept on file at the employee's home office and can be provided upon request.

4.17.2 Medical Surveillance

Personnel engaged in hazardous waste operations must be enrolled in a medical monitoring program as required by 29 CFR 1910.120(f). A physician's letter or statement attesting to each

individual's fitness for duty must be maintained on file at each employee's home office and can be provided upon request.

4.18 Recordkeeping

The SSO will establish and maintain documents regarding Health and Safety records; reports; and information concerning individual training, medical surveillance, etc. Sections in this filing system will include:

- Personnel Records – Certificates for training required under 29 CFR 120, medical examination summary letters or certifications, monitoring results, etc.
- Training – Sign-in sheets for on-site training with topics and dates.
- Visitor Logs – Sign-in sheets for site visitors.
- Inspection Reports – Reports of daily inspections by SSO and others concerning health and safety issues.
- Accident Prevention – Copies of all hazard analyses performed on new tasks or activities. Copies of any accident/incident reports and follow-up reports. Other pertinent correspondence.
- PPE – Records of periodic inspection, testing and maintenance performed on PPE.

Health & Safety Plan Acceptance

I have had the opportunity to read and ask questions about this HASP. My signature certifies that I understand the procedures, equipment, and restrictions of this plan and agree to abide by them. By signing below, all personnel are indicating they have received and are current with their medical surveillance and training certification; in accordance with 29 CFR 1910.120 and AMEC corporate health and safety policies.

Signature*	Printed Name	Company	Date

* This acceptance form is required for all routine site staff, visitors, and other subcontractors not specifically covered under another site-specific HASP. When possible, subcontractors and other non-AMEC personnel will be covered by a site-specific HASP (that meets or exceeds AMEC's HASP) generated by their respective company.

Attachment A

Toxic Substance Fact Sheet - PCBs

ATSDR
AGENCY FOR TOXIC SUBSTANCES AND DISEASE REGISTRY

POLYCHLORINATED BIPHENYLS

Division of Toxicology ToxFAQs™ **February 2001**

This fact sheet answers the most frequently asked health questions (FAQs) about polychlorinated biphenyls. For more information, call the ATSDR Information Center at 1-888-422-8737. This fact sheet is one in a series of summaries about hazardous substances and their health effects. It's important you understand this information because this substance may harm you. The effects of exposure to any hazardous substance depend on the dose, the duration, how you are exposed, personal traits and habits, and whether other chemicals are present.

HIGHLIGHTS: Polychlorinated biphenyls (PCBs) are a mixture of individual chemicals which are no longer produced in the United States, but are still found in the environment. Health effects that have been associated with exposure to PCBs include acne-like skin conditions in adults and neurobehavioral and immunological changes in children. PCBs are known to cause cancer in animals. PCBs have been found in at least 500 of the 1,598 National Priorities List sites identified by the Environmental Protection Agency (EPA).

What are polychlorinated biphenyls?

Polychlorinated biphenyls are mixtures of up to 209 individual chlorinated compounds (known as congeners). There are no known natural sources of PCBs. PCBs are either oily liquids or solids that are colorless to light yellow. Some PCBs can exist as a vapor in air. PCBs have no known smell or taste. Many commercial PCB mixtures are known in the U.S. by the trade name Aroclor.

PCBs have been used as coolants and lubricants in transformers, capacitors, and other electrical equipment because they don't burn easily and are good insulators. The manufacture of PCBs was stopped in the U.S. in 1977 because of evidence they build up in the environment and can cause harmful health effects. Products made before 1977 that may contain PCBs include old fluorescent lighting fixtures and electrical devices containing PCB capacitors, and old microscope and hydraulic oils.

What happens to PCBs when they enter the environment?

❑ PCBs entered the air, water, and soil during their manufacture, use, and disposal; from accidental spills and leaks during their transport; and from leaks or fires in products containing PCBs.

❑ PCBs can still be released to the environment from hazardous waste sites; illegal or improper disposal of industrial wastes and consumer products; leaks from old electrical transformers containing PCBs; and burning of some wastes in incinerators.

❑ PCBs do not readily break down in the environment and thus may remain there for very long periods of time. PCBs can travel long distances in the air and be deposited in areas far away from where they were released. In water, a small amount of PCBs may remain dissolved, but most stick to organic particles and bottom sediments. PCBs also bind strongly to soil.

❑ PCBs are taken up by small organisms and fish in water. They are also taken up by other animals that eat these aquatic animals as food. PCBs accumulate in fish and marine mammals, reaching levels that may be many thousands of times higher than in water.

How might I be exposed to PCBs?

❑ Using old fluorescent lighting fixtures and electrical devices and appliances, such as television sets and refrigerators, that were made 30 or more years ago. These items may leak small amounts of PCBs into the air when they get hot during operation, and could be a source of skin exposure.

❑ Eating contaminated food. The main dietary sources of PCBs are fish (especially sportfish caught in contaminated lakes or rivers), meat, and dairy products.

❑ Breathing air near hazardous waste sites and drinking contaminated well water.

❑ In the workplace during repair and maintenance of PCB transformers; accidents, fires or spills involving transformers, fluorescent lights, and other old electrical devices; and disposal of PCB materials.

How can PCBs affect my health?

The most commonly observed health effects in people exposed to large amounts of PCBs are skin conditions such as acne and rashes. Studies in exposed workers have shown changes in blood and urine that may indicate liver damage. PCB exposures in the general population are not likely to result in skin and liver effects. Most of the studies of health effects of PCBs in the general population examined children of mothers who were exposed to PCBs.

Animals that ate food containing large amounts of PCBs for short periods of time had mild liver damage and some died. Animals that ate smaller amounts of PCBs in food over several weeks or months developed various kinds of health effects, including anemia; acne-like skin conditions; and liver, stomach, and thyroid gland injuries. Other effects

of PCBs in animals include changes in the immune system, behavioral alterations, and impaired reproduction. PCBs are not known to cause birth defects.

How likely are PCBs to cause cancer?

Few studies of workers indicate that PCBs were associated with certain kinds of cancer in humans, such as cancer of the liver and biliary tract. Rats that ate food containing high levels of PCBs for two years developed liver cancer. The Department of Health and Human Services (DHHS) has concluded that PCBs may reasonably be anticipated to be carcinogens. The EPA and the International Agency for Research on Cancer (IARC) have determined that PCBs are probably carcinogenic to humans.

How can PCBs affect children?

Women who were exposed to relatively high levels of PCBs in the workplace or ate large amounts of fish contaminated with PCBs had babies that weighed slightly less than babies from women who did not have these exposures. Babies born to women who ate PCB-contaminated fish also showed abnormal responses in tests of infant behavior. Some of these behaviors, such as problems with motor skills and a decrease in short-term memory, lasted for several years. Other studies suggest that the immune system was affected in children born to and nursed by mothers exposed to increased levels of PCBs. There are no reports of structural birth defects caused by exposure to PCBs or of health effects of PCBs in older children. The most likely way infants will be exposed to PCBs is from breast milk. Transplacental transfers of PCBs were also reported In most cases, the benefits of breast-feeding outweigh any risks from exposure to PCBs in mother's milk.

How can families reduce the risk of exposure to PCBs?

❑ You and your children may be exposed to PCBs by eating fish or wildlife caught from contaminated locations. Certain states, Native American tribes, and U.S. territories have issued advisories to warn people about PCB-contaminated fish and fish-eating wildlife. You can reduce your family's exposure to PCBs by obeying these advisories.

❑ Children should be told not play with old appliances, electrical equipment, or transformers, since they may contain PCBs.

❑ Children should be discouraged from playing in the dirt near hazardous waste sites and in areas where there was a transformer fire. Children should also be discouraged from eating dirt and putting dirty hands, toys or other objects in their mouths, and should wash hands frequently.

❑ If you are exposed to PCBs in the workplace it is possible to carry them home on your clothes, body, or tools. If this is the case, you should shower and change clothing before leaving work, and your work clothes should be kept separate from other clothes and laundered separately.

Is there a medical test to show whether I've been exposed to PCBs?

Tests exist to measure levels of PCBs in your blood, body fat, and breast milk, but these are not routinely conducted. Most people normally have low levels of PCBs in their body because nearly everyone has been environmentally exposed to PCBs. The tests can show if your PCB levels are elevated, which would indicate past exposure to above-normal levels of PCBs, but cannot determine when or how long you were exposed or whether you will develop health effects.

Has the federal government made recommendations to protect human health?

The EPA has set a limit of 0.0005 milligrams of PCBs per liter of drinking water (0.0005 mg/L). Discharges, spills or accidental releases of 1 pound or more of PCBs into the environment must be reported to the EPA. The Food and Drug Administration (FDA) requires that infant foods, eggs, milk and other dairy products, fish and shellfish, poultry and red meat contain no more than 0.2-3 parts of PCBs per million parts (0.2-3 ppm) of food. Many states have established fish and wildlife consumption advisories for PCBs.

References

Agency for Toxic Substances and Disease Registry (ATSDR). 2000. Toxicological profile for polychlorinated biphenyls (PCBs). Atlanta, GA: U.S. Department of Health and Human Services, Public Health Service.

Where can I get more information? For more information, contact the Agency for Toxic Substances and Disease Registry, Division of Toxicology, 1600 Clifton Road NE, Mailstop F-32, Atlanta, GA 30333. Phone: 1-888-422-8737, FAX: 770-488-4178. ToxFAQs™ Internet address is http://www.atsdr.cdc.gov/toxfaq.html . ATSDR can tell you where to find occupational and environmental health clinics. Their specialists can recognize, evaluate, and treat illnesses resulting from exposure to hazardous substances. You can also contact your community or state health or environmental quality department if you have any more questions or concerns.

Attachment B

Map to Local Hospital

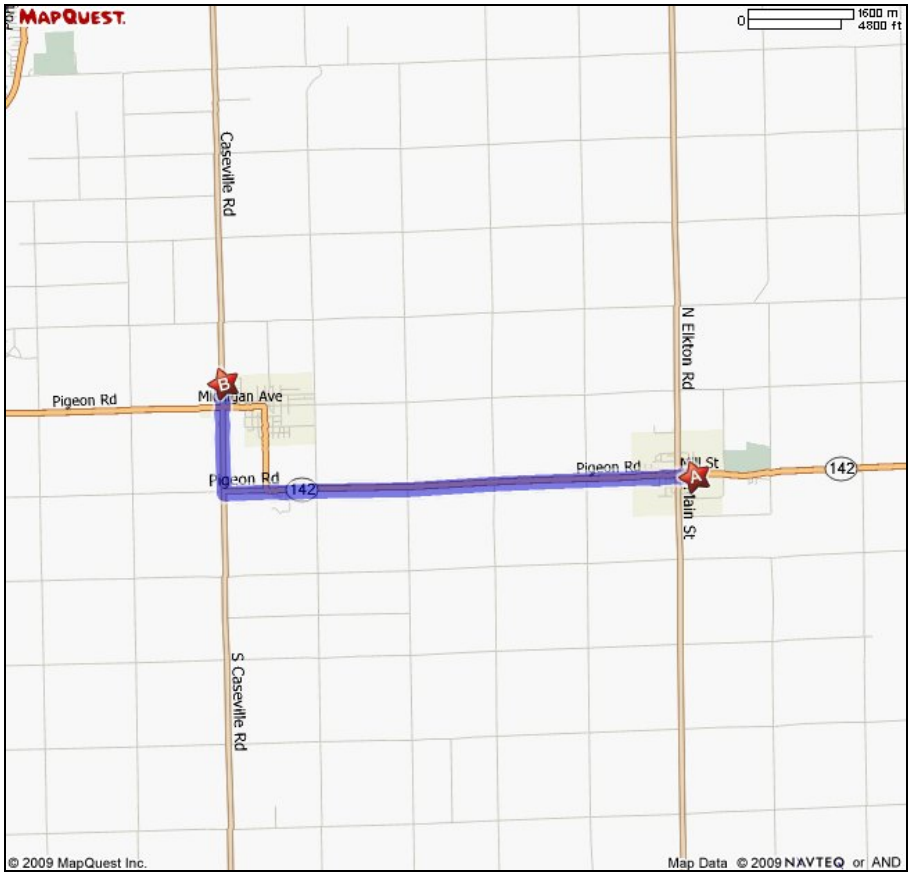
ROUTE TO HOSPITAL

Address
Scheurer Hospital
170 North Caseville Road
Pigeon, Michigan 48755
(989) 453-3223

Directions

1) **SOUTH on Drettman Drive toward Mill Street / MI-142 (0.0 mile)**
2) **RIGHT onto Mill Street / MI-142 (4.6 miles)**
3) **Stay STRAIGHT onto Pigeon Road (0.5 mile)**
4) **RIGHT onto S. Caseville Road (1.3 miles)**

Total Time = 9 minutes
Total Distance = 6.38 miles



Attachment C

Job Safety Analysis/Hazard Analysis

HAZARD EVALUATION

HAZARD ANALYSIS OF SITE WORK TASKS

Task Name: Construction Oversight

Potential Hazards: (*Check all that apply to either existing conditions or are a result of site operations*)

( ) Rotating machinery
(X) Heat stress
( ) Work over water (lagoons, streambeds, ravines, bay, ocean)
( ) Projectiles
( ) Physical exertion
(X) Uneven terrain
( ) Confined space
(X) Biological (plants, rodent viruses, marine species, soil- or waterborne fungi/bacteria, insects, arachnids, snakes, wild animals)†
(X) Slips, trips, falls
( ) Cold stress
(X) Heavy equipment
( ) Trench/excavation collapse
(X) Noise (>85 dBA)
( ) Vehicle traffic
(X) Electrical (utilities)
(X) Chemical exposure
( ) Explosive ordnance
( ) Intrusive activ's‡ (underline)
- Excavating
- Sampling
- Vibracoring

( ) Fire/explosion (underline)
- Flam. materials
- Low-lying areas
- Fuel lines

( ) Other (list)
Drum Handling
Facility Operations
Heavy Lifting (>50 lbs)

‡ Determine if underground utilities are present by using all relevant maps and building plans. Call Underground Service Alert (USA) 1-800-422-4133. **In Michigan call Miss Dig at 1-800-482-7171**.

* If sampling for the purpose of determining the presence or absence of hazardous materials, a site-specific HSP in accordance with 29 CFR 1910.120 is required by law. Consult the SHE Coordinator.

† Insects such as bees and wasps. Arachnids such as ticks, scorpions, and spiders. Marine species may include jellyfish, stingrays, sea urchins, rock fish, stone fish, sharks, and coral. Consult with the Corporate SHE Director or regional SHE Manager for protective measures against viruses or fungi.

Control or Protective Measures: (*Check all that apply*)

(X) Tailgate meetings
(X) Operator training
( ) Engineering controls: _____
(X) SOPs: See HASP
( ) Other: _____
(X) PPE
(X) Site control
(X) Safe work practices

PERSONAL PROTECTIVE EQUIPMENT

Initial levels of protection have been assigned per work task. Levels may be upgraded or downgraded depending on site conditions, as determined by the SHSC.

RESPIRATOR: ( ) Air-purifying Respirator (medical monitoring required) ( ) Other _____

PROTECTIVE CLOTHING: ( ) Tyvek® ( ) PE Tyvek® ( ) Wetsuit ( ) Drysuit ( ) Other _____

HEAD/EYE/EAR: (X) Hard Hat (X) Safety Glasses ( ) Goggles ( ) Earplugs/Muffs ( ) Other _____

GLOVES: (X) Leather Work Gloves ( ) Neoprene ( ) PVC ( ) Vinyl (X) Other Nitrile _____

FOOTWEAR: (X) Safety-toe Leather ( ) Safety-toe Rubber ( ) Overboots ( ) Snakeguards ( ) Other_____

Modifications Permitted: Neon Orange Safety Vest

HAZARD EVALUATION

HAZARD ANALYSIS OF SITE WORK TASKS

Task Name: Excavation and Trenching

Potential Hazards: (*Check all that apply to either existing conditions or are a result of site operations*)

( ) Rotating machinery
(X) Heat stress
( ) Work over water (lagoons, streambeds, ravines, bay, ocean)
( ) Projectiles
( ) Physical exertion
(X) Uneven terrain
( ) Confined space
(X) Biological (plants, rodent viruses, marine species, soil- or waterborne fungi/bacteria, insects, arachnids, snakes, wild animals)†
(X) Slips, trips, falls
( ) Cold stress
(X) Heavy equipment
(X) Trench/excavation collapse
(X) Noise (>85 dBA)
( ) Vehicle traffic
(X) Electrical (utilities)
(X) Chemical exposure
( ) Explosive ordnance
(X) Intrusive activ's‡ (underline)
- Excavating
- Sampling
- Vibracoring

( ) Fire/explosion (underline)
- Flam. materials
- Low-lying areas
- Fuel lines

( ) Other (list)
Drum Handling
Facility Operations
Heavy Lifting (>50 lbs)

‡ Determine if underground utilities are present by using all relevant maps and building plans. Call Underground Service Alert (USA) 1-800-422-4133. **In Michigan call Miss Dig at 1-800-482-7171**.

* If sampling for the purpose of determining the presence or absence of hazardous materials, a site-specific HSP in accordance with 29 CFR 1910.120 is required by law. Consult the SHE Coordinator.

† Insects such as bees and wasps. Arachnids such as ticks, scorpions, and spiders. Marine species may include jellyfish, stingrays, sea urchins, rock fish, stone fish, sharks, and coral. Consult with the Corporate SHE Director or regional SHE Manager for protective measures against viruses or fungi.

Control or Protective Measures: (*Check all that apply*)

(X) Tailgate meetings
(X) Operator training
(X) PPE
(X) Site control
(X) Safe work practices
( ) Engineering controls: _____
(X) SOPs: See HASP
( ) Other: _____

PERSONAL PROTECTIVE EQUIPMENT

Initial levels of protection have been assigned per work task. Levels may be upgraded or downgraded depending on site conditions, as determined by the SHSC.

RESPIRATOR: ( ) Air-purifying Respirator (medical monitoring required) ( ) Other _____

PROTECTIVE CLOTHING: ( ) Tyvek® ( ) PE Tyvek® ( ) Wetsuit ( ) Drysuit ( ) Other _____

HEAD/EYE/EAR: (X) Hard Hat (X) Safety Glasses ( ) Goggles ( ) Earplugs/Muffs ( ) Other _____

GLOVES: (X) Leather Work Gloves ( ) Neoprene ( ) PVC ( ) Vinyl (X) Other Nitrile _____

FOOTWEAR: (X) Safety-toe Leather ( ) Safety-toe Rubber ( ) Overboots ( ) Snakeguards ( ) Other_____

Modifications Permitted: Neon Orange Safety Vest

HAZARD EVALUATION

HAZARD ANALYSIS OF SITE WORK TASKS

Task Name: Working Near Overhead Utilities

Potential Hazards: (*Check all that apply to either existing conditions or are a result of site operations*)

(X) Rotating machinery
( ) Heat stress
( ) Work over water (lagoons, streambeds, ravines, bay, ocean)
( ) Projectiles
( ) Physical exertion
(X) Uneven terrain
( ) Confined space
( ) Biological (plants, rodent viruses, marine species, soil- or waterborne fungi/bacteria, insects, arachnids, snakes, wild animals)†
( ) Slips, trips, falls
( ) Cold stress
(X) Heavy equipment
( ) Trench/excavation collapse
( ) Noise (>85 dBA)
( ) Vehicle traffic
(X) Electrical (utilities)
( ) Chemical exposure
( ) Explosive ordnance
( ) Intrusive activ's‡ (underline)
- Excavating
- Sampling
- Vibracoring

( ) Fire/explosion (underline)
- Flam. materials
- Low-lying areas
- Fuel lines

( ) Other (list)
Drum Handling
Facility Operations
Heavy Lifting (>50 lbs)

‡ Determine if underground utilities are present by using all relevant maps and building plans. Call Underground Service Alert (USA) 1-800-422-4133. **In Michigan call Miss Dig at 1-800-482-7171**.

* If sampling for the purpose of determining the presence or absence of hazardous materials, a site-specific HSP in accordance with 29 CFR 1910.120 is required by law. Consult the SHE Coordinator.

† Insects such as bees and wasps. Arachnids such as ticks, scorpions, and spiders. Marine species may include jellyfish, stingrays, sea urchins, rock fish, stone fish, sharks, and coral. Consult with the Corporate SHE Director or regional SHE Manager for protective measures against viruses or fungi.

Control or Protective Measures: (*Check all that apply*)

(X) Tailgate meetings
(X) Operator training
( ) Engineering controls: _____
(X) SOPs: See HASP
( ) Other: _____
(X) PPE
(X) Site control
(X) Safe work practices

PERSONAL PROTECTIVE EQUIPMENT

Initial levels of protection have been assigned per work task. Levels may be upgraded or downgraded depending on site conditions, as determined by the SHSC.

RESPIRATOR: ( ) Air-purifying Respirator (medical monitoring required) ( ) Other _____

PROTECTIVE CLOTHING: ( ) Tyvek® ( ) PE Tyvek® ( ) Wetsuit ( ) Drysuit ( ) Other _____

HEAD/EYE/EAR: (X) Hard Hat (X) Safety Glasses ( ) Goggles ( ) Earplugs/Muffs ( ) Other _____

GLOVES: (X) Leather Work Gloves ( ) Neoprene ( ) PVC ( ) Vinyl (X) Other Nitrile _____

FOOTWEAR: (X) Safety-toe Leather ( ) Safety-toe Rubber ( ) Overboots ( ) Snakeguards ( ) Other_____

Modifications Permitted: Neon Orange Safety Vest

HAZARD EVALUATION

HAZARD ANALYSIS OF SITE WORK TASKS

Task Name: Heavy Equipment Operation

Potential Hazards: (*Check all that apply to either existing conditions or are a result of site operations*)

(X) Rotating machinery
(X) Heat stress
( ) Work over water (lagoons, streambeds, ravines, bay, ocean)
( ) Projectiles
( ) Physical exertion
(X) Uneven terrain
( ) Confined space
( ) Biological (plants, rodent viruses, marine species, soil- or waterborne fungi/bacteria, insects, arachnids, snakes, wild animals)†
(X) Slips, trips, falls
( ) Cold stress
(X) Heavy equipment
( ) Trench/excavation collapse
( ) Noise (>85 dBA)
( ) Vehicle traffic
(X) Electrical (utilities)
( ) Chemical exposure
( ) Explosive ordnance
( ) Intrusive activ's‡ (underline)
- Excavating
- Sampling
- Vibracoring

( ) Fire/explosion (underline)
- Flam. materials
- Low-lying areas
- Fuel lines

( ) Other (list)
Drum Handling
Facility Operations
Heavy Lifting (>50 lbs)

‡ Determine if underground utilities are present by using all relevant maps and building plans. Call Underground Service Alert (USA) 1-800-422-4133. **In Michigan call Miss Dig at 1-800-482-7171**.

* If sampling for the purpose of determining the presence or absence of hazardous materials, a site-specific HSP in accordance with 29 CFR 1910.120 is required by law. Consult the SHE Coordinator.

† Insects such as bees and wasps. Arachnids such as ticks, scorpions, and spiders. Marine species may include jellyfish, stingrays, sea urchins, rock fish, stone fish, sharks, and coral. Consult with the Corporate SHE Director or regional SHE Manager for protective measures against viruses or fungi.

Control or Protective Measures: (*Check all that apply*)

(X) Tailgate meetings
(X) Operator training
(X) PPE
(X) Site control
(X) Safe work practices
( ) Engineering controls: _____
(X) SOPs: See HASP
( ) Other: _____

PERSONAL PROTECTIVE EQUIPMENT

Initial levels of protection have been assigned per work task. Levels may be upgraded or downgraded depending on site conditions, as determined by the SHSC.

RESPIRATOR: ( ) Air-purifying Respirator (medical monitoring required) ( ) Other _____

PROTECTIVE CLOTHING: ( ) Tyvek® ( ) PE Tyvek® ( ) Wetsuit ( ) Drysuit ( ) Other _____

HEAD/EYE/EAR: (X) Hard Hat (X) Safety Glasses ( ) Goggles ( ) Earplugs/Muffs ( ) Other _____

GLOVES: (X) Leather Work Gloves ( ) Neoprene ( ) PVC ( ) Vinyl (X) Other Nitrile _____

FOOTWEAR: (X) Safety-toe Leather ( ) Safety-toe Rubber ( ) Overboots ( ) Snakeguards ( ) Other_____

Modifications Permitted: Neon Orange Safety Vest

HAZARD EVALUATION

HAZARD ANALYSIS OF SITE WORK TASKS

Task Name: Loading/Transportation of Soil

Potential Hazards: (*Check all that apply to either existing conditions or are a result of site operations*)

(X) Rotating machinery
(X) Heat stress
( ) Work over water (lagoons, streambeds, ravines, bay, ocean)
( ) Projectiles
( ) Physical exertion
(X) Uneven terrain
( ) Confined space
( ) Biological (plants, rodent viruses, marine species, soil- or waterborne fungi/bacteria, insects, arachnids, snakes, wild animals)†
(X) Slips, trips, falls
( ) Cold stress
(X) Heavy equipment
( ) Trench/excavation collapse
( ) Noise (>85 dBA)
(X) Vehicle traffic
(X) Electrical (utilities)
( ) Chemical exposure
( ) Explosive ordnance
( ) Intrusive activ's‡ (underline)
- Excavating
- Sampling
- Vibracoring

( ) Fire/explosion (underline)
- Flam. materials
- Low-lying areas
- Fuel lines

( ) Other (list)
Drum Handling
Facility Operations
Heavy Lifting (>50 lbs)

‡ Determine if underground utilities are present by using all relevant maps and building plans. Call Underground Service Alert (USA) 1-800-422-4133. **In Michigan call Miss Dig at 1-800-482-7171**.

* If sampling for the purpose of determining the presence or absence of hazardous materials, a site-specific HSP in accordance with 29 CFR 1910.120 is required by law. Consult the SHE Coordinator.

† Insects such as bees and wasps. Arachnids such as ticks, scorpions, and spiders. Marine species may include jellyfish, stingrays, sea urchins, rock fish, stone fish, sharks, and coral. Consult with the Corporate SHE Director or regional SHE Manager for protective measures against viruses or fungi.

Control or Protective Measures: (*Check all that apply*)

(X) Tailgate meetings
(X) Operator training
(X) PPE
(X) Site control
(X) Safe work practices
( ) Engineering controls: _____
(X) SOPs: See HASP
( ) Other: _____

PERSONAL PROTECTIVE EQUIPMENT

Initial levels of protection have been assigned per work task. Levels may be upgraded or downgraded depending on site conditions, as determined by the SHSC.

RESPIRATOR: ( ) Air-purifying Respirator (medical monitoring required) ( ) Other _____

PROTECTIVE CLOTHING: ( ) Tyvek® ( ) PE Tyvek® ( ) Wetsuit ( ) Drysuit ( ) Other _____

HEAD/EYE/EAR: (X) Hard Hat (X) Safety Glasses ( ) Goggles ( ) Earplugs/Muffs ( ) Other _____

GLOVES: (X) Leather Work Gloves ( ) Neoprene ( ) PVC ( ) Vinyl (X) Other Nitrile _____

FOOTWEAR: (X) Safety-toe Leather ( ) Safety-toe Rubber ( ) Overboots ( ) Snakeguards ( ) Other_____

Modifications Permitted: Neon Orange Safety Vest

HAZARD EVALUATION

HAZARD ANALYSIS OF SITE WORK TASKS

Task Name: Soil Boring Completion via Geoprobe™/Direct Push Rig

Potential Hazards: (*Check all that apply to either existing conditions or are a result of site operations*)

( ) Rotating machinery
(X) Heat stress
( ) Work over water (lagoons, streambeds, ravines, bay, ocean)
( ) Projectiles
(X) Physical exertion
(X) Uneven terrain
( ) Confined space
(X) Biological (plants, rodent viruses, marine species, soil- or waterborne fungi/bacteria, insects, arachnids, snakes, wild animals)†
(X) Slips, trips, falls
( ) Cold stress
(X) Heavy equipment
( ) Trench/excavation collapse
(X) Noise (>85 dBA)
(X) Vehicle traffic
(X) Electrical (utilities)
(X) Chemical exposure
( ) Explosive ordnance
(X) Intrusive activ's‡ (underline)
- Excavating
- Sampling
- Vibracoring

( ) Fire/explosion (underline)
- Flam. materials
- Low-lying areas
- Fuel lines

(X) Other (list)
Underground Utilities
Facility Operations
Heavy Lifting (>50 lbs)

‡ Determine if underground utilities are present by using all relevant maps and building plans. Call Underground Service Alert (USA) 1-800-422-4133.

* If sampling for the purpose of determining the presence or absence of hazardous materials, a site-specific HSP in accordance with 29 CFR 1910.120 is required by law. Consult the SHE Coordinator.

† Insects such as bees and wasps. Arachnids such as ticks, scorpions, and spiders. Marine species may include jellyfish, stingrays, sea urchins, rock fish, stone fish, sharks, and coral. Consult with the Corporate SHE Director or regional SHE Manager for protective measures against viruses or fungi.

Control or Protective Measures: (*Check all that apply*)

(X) Tailgate meetings
(X) Operator training
(X) PPE
(X) Site control
(X) Safe work practices
( ) Engineering controls: _____
(X) SOPs: See HASP
( ) Other: _____

PERSONAL PROTECTIVE EQUIPMENT

Initial levels of protection have been assigned per work task. Levels may be upgraded or downgraded depending on site conditions, as determined by the SHSC.

RESPIRATOR: ( ) Air-purifying Respirator (medical monitoring required) ( ) Other _____

PROTECTIVE CLOTHING: ( ) Tyvek® ( ) PE Tyvek® ( ) Wetsuit ( ) Drysuit ( ) Other _____

HEAD/EYE/EAR: (X) Hard Hat (X) Safety Glasses ( ) Goggles (X) Earplugs/Muffs ( ) Other _____

GLOVES: (X) Leather Work Gloves ( ) Neoprene ( ) PVC ( ) Vinyl (X) Other Nitrile _____

FOOTWEAR: (X) Safety-toe Leather ( ) Safety-toe Rubber (X) Overboots ( ) Snakeguards ( ) Other_____

Modifications Permitted: Neon Orange Safety Vest

HAZARD EVALUATION

HAZARD ANALYSIS OF SITE WORK TASKS

Task Name: Soil/Sediment Sample Collection

Potential Hazards: (*Check all that apply to either existing conditions or are a result of site operations*)

( ) Rotating machinery
(X) Heat stress
( ) Work over water (lagoons, streambeds, ravines, bay, ocean)
( ) Projectiles
(X) Physical exertion
(X) Uneven terrain
( ) Confined space
(X) Biological (plants, rodent viruses, marine species, soil- or waterborne fungi/bacteria, insects, arachnids, snakes, wild animals)†
(X) Slips, trips, falls
( ) Cold stress
(X) Heavy equipment
( ) Trench/excavation collapse
(X) Noise (>85 dBA)
(X) Vehicle traffic
(X) Electrical (utilities)
(X) Chemical exposure
( ) Explosive ordnance
(X) Intrusive activ's‡ (underline)
- Excavating
- Sampling
- Vibracoring

( ) Fire/explosion (underline)
- Flam. materials
- Low-lying areas
- Fuel lines

(X) Other (list)
Underground Utilities
Facility Operations
Heavy Lifting (>50 lbs)

‡ Determine if underground utilities are present by using all relevant maps and building plans. Call Underground Service Alert (USA) 1-800-422-4133.

* If sampling for the purpose of determining the presence or absence of hazardous materials, a site-specific HSP in accordance with 29 CFR 1910.120 is required by law. Consult the SHE Coordinator.

† Insects such as bees and wasps. Arachnids such as ticks, scorpions, and spiders. Marine species may include jellyfish, stingrays, sea urchins, rock fish, stone fish, sharks, and coral. Consult with the Corporate SHE Director or regional SHE Manager for protective measures against viruses or fungi.

Control or Protective Measures: (*Check all that apply*)

(X) Tailgate meetings
(X) Operator training
(X) PPE
(X) Site control
(X) Safe work practices
( ) Engineering controls: _____
(X) SOPs: See HASP
( ) Other: _____

PERSONAL PROTECTIVE EQUIPMENT

Initial levels of protection have been assigned per work task. Levels may be upgraded or downgraded depending on site conditions, as determined by the SHSC.

RESPIRATOR: ( ) Air-purifying Respirator (medical monitoring required) ( ) Other _____

PROTECTIVE CLOTHING: ( ) Tyvek® ( ) PE Tyvek® ( ) Wetsuit ( ) Drysuit ( ) Other _____

HEAD/EYE/EAR: (X) Hard Hat (X) Safety Glasses ( ) Goggles (X) Earplugs/Muffs ( ) Other _____

GLOVES: (X) Leather Work Gloves ( ) Neoprene ( ) PVC ( ) Vinyl (X) Other Nitrile _____

FOOTWEAR: (X) Safety-toe Leather ( ) Safety-toe Rubber (X) Overboots ( ) Snakeguards ( ) Other_____

Modifications Permitted: Neon Orange Safety Vest

HAZARD EVALUATION

HAZARD ANALYSIS OF SITE WORK TASKS

Task Name: Borehole Abandonment

Potential Hazards: (*Check all that apply to either existing conditions or are a result of site operations*)

( ) Rotating machinery
(X) Heat stress
( ) Work over water (lagoons, streambeds, ravines, bay, ocean)
( ) Projectiles
(X) Physical exertion
(X) Uneven terrain
( ) Confined space
(X) Biological (plants, rodent viruses, marine species, soil- or waterborne fungi/bacteria, insects, arachnids, snakes, wild animals)†
(X) Slips, trips, falls
( ) Cold stress
( ) Heavy equipment
( ) Trench/excavation collapse
( ) Noise (>85 dBA)
(X) Vehicle traffic
( ) Electrical (utilities)
(X) Chemical exposure
( ) Explosive ordnance
( ) Intrusive activ's‡ (underline)
- Excavating
- Sampling
- Vibracoring

( ) Fire/explosion (underline)
- Flam. materials
- Low-lying areas
- Fuel lines

(X) Other (list)
Heavy Lifting (>50 lbs)
Facility Operations

‡ Determine if underground utilities are present by using all relevant maps and building plans. Call Underground Service Alert (USA) 1-800-422-4133.

* If sampling for the purpose of determining the presence or absence of hazardous materials, a site-specific HSP in accordance with 29 CFR 1910.120 is required by law. Consult the SHE Coordinator.

† Insects such as bees and wasps. Arachnids such as ticks, scorpions, and spiders. Marine species may include jellyfish, stingrays, sea urchins, rock fish, stone fish, sharks, and coral. Consult with the Corporate SHE Director or regional SHE Manager for protective measures against viruses or fungi.

Control or Protective Measures: (*Check all that apply*)

(X) Tailgate meetings
( ) Operator training
( ) Engineering controls: _____
(X) SOPs: See HASP
( ) Other: _____
(X) PPE
(X) Site control
(X) Safe work practices

PERSONAL PROTECTIVE EQUIPMENT

Initial levels of protection have been assigned per work task. Levels may be upgraded or downgraded depending on site conditions, as determined by the SHSC.

RESPIRATOR: ( ) Air-purifying Respirator (medical monitoring required) ( ) Other _____

PROTECTIVE CLOTHING: ( ) Tyvek® ( ) PE Tyvek® ( ) Wetsuit ( ) Drysuit ( ) Other _____

HEAD/EYE/EAR: (X) Hard Hat (X) Safety Glasses ( ) Goggles ( ) Earplugs/Muffs ( ) Other _____

GLOVES: (X) Leather Work Gloves ( ) Neoprene ( ) PVC ( ) Vinyl (X) Other Nitrile _____

FOOTWEAR: (X) Safety-toe Leather ( ) Safety-toe Rubber (X) Overboots ( ) Snakeguards ( ) Other_____

Modifications Permitted: Neon Orange Safety Vest

HAZARD EVALUATION

HAZARD ANALYSIS OF SITE WORK TASKS

Task Name: Sewer Survey

Potential Hazards: (*Check all that apply to either existing conditions or are a result of site operations*)

( ) Rotating machinery
(X) Heat stress
( ) Work over water (lagoons, streambeds, ravines, bay, ocean)
( ) Projectiles
(X) Physical exertion
(X) Uneven terrain
( ) Confined space
(X) Biological (plants, rodent viruses, marine species, soil- or waterborne fungi/bacteria, insects, arachnids, snakes, wild animals)†
(X) Slips, trips, falls
( ) Cold stress
(X) Heavy equipment
( ) Trench/excavation collapse
(X) Noise (>85 dBA)
(X) Vehicle traffic
( ) Electrical (utilities)
(X) Chemical exposure
( ) Explosive ordnance
( ) Intrusive activ's‡ (underline)
- Excavating
- Sampling
- Vibracoring

( ) Fire/explosion (underline)
- Flam. materials
- Low-lying areas
- Fuel lines

(X) Other (list)
Heavy Lifting (>50 lbs)
Facility Operations

‡ Determine if underground utilities are present by using all relevant maps and building plans. Call Underground Service Alert (USA) 1-800-422-4133.

* If sampling for the purpose of determining the presence or absence of hazardous materials, a site-specific HSP in accordance with 29 CFR 1910.120 is required by law. Consult the SHE Coordinator.

† Insects such as bees and wasps. Arachnids such as ticks, scorpions, and spiders. Marine species may include jellyfish, stingrays, sea urchins, rock fish, stone fish, sharks, and coral. Consult with the Corporate SHE Director or regional SHE Manager for protective measures against viruses or fungi.

Control or Protective Measures: (*Check all that apply*)

(X) Tailgate meetings
(X) Operator training
( ) Engineering controls: _____
(X) SOPs: See HASP
( ) Other: _____
(X) PPE
(X) Site control
(X) Safe work practices

PERSONAL PROTECTIVE EQUIPMENT

Initial levels of protection have been assigned per work task. Levels may be upgraded or downgraded depending on site conditions, as determined by the SHSC.

RESPIRATOR: ( ) Air-purifying Respirator (medical monitoring required) ( ) Other _____

PROTECTIVE CLOTHING: ( ) Tyvek® ( ) PE Tyvek® ( ) Wetsuit ( ) Drysuit ( ) Other _____

HEAD/EYE/EAR: (X) Hard Hat (X) Safety Glasses ( ) Goggles (X) Earplugs/Muffs ( ) Other _____

GLOVES: (X) Leather Work Gloves ( ) Neoprene ( ) PVC ( ) Vinyl (X) Other Nitrile _____

FOOTWEAR: (X) Safety-toe Leather ( ) Safety-toe Rubber (X) Overboots ( ) Snakeguards ( ) Other_____

Modifications Permitted: Neon Orange Safety Vest

HAZARD EVALUATION

HAZARD ANALYSIS OF SITE WORK TASKS

Task Name: Handling and Sampling Investigation-Derived Waste

Potential Hazards: (*Check all that apply to either existing conditions or are a result of site operations*)

( ) Rotating machinery
(X) Heat stress
( ) Work over water (lagoons, streambeds, ravines, bay, ocean)
( ) Projectiles
(X) Physical exertion
(X) Uneven terrain
( ) Confined space
(X) Biological (plants, rodent viruses, marine species, soil- or waterborne fungi/bacteria, insects, arachnids, snakes, wild animals)†
(X) Slips, trips, falls
( ) Cold stress
(X) Heavy equipment
( ) Trench/excavation collapse
( ) Noise (>85 dBA)
(X) Vehicle traffic
( ) Electrical (utilities)
(X) Chemical exposure
( ) Explosive ordnance
( ) Intrusive activ's‡ (underline)
- Excavating
- Sampling
- Vibracoring

( ) Fire/explosion (underline)
- Flam. materials
- Low-lying areas
- Fuel lines

(X) Other (list)
Drum Handling
Facility Operations
Heavy Lifting (>50 lbs)

‡ Determine if underground utilities are present by using all relevant maps and building plans. Call Underground Service Alert (USA) 1-800-422-4133.

* If sampling for the purpose of determining the presence or absence of hazardous materials, a site-specific HSP in accordance with 29 CFR 1910.120 is required by law. Consult the SHE Coordinator.

† Insects such as bees and wasps. Arachnids such as ticks, scorpions, and spiders. Marine species may include jellyfish, stingrays, sea urchins, rock fish, stone fish, sharks, and coral. Consult with the Corporate SHE Director or regional SHE Manager for protective measures against viruses or fungi.

Control or Protective Measures: (*Check all that apply*)

(X) Tailgate meetings
(X) Operator training
(X) PPE
(X) Site control
(X) Safe work practices
( ) Engineering controls: _____
(X) SOPs: See HASP
( ) Other: _____

PERSONAL PROTECTIVE EQUIPMENT

Initial levels of protection have been assigned per work task. Levels may be upgraded or downgraded depending on site conditions, as determined by the SHSC.

RESPIRATOR: ( ) Air-purifying Respirator (medical monitoring required) ( ) Other _____

PROTECTIVE CLOTHING: ( ) Tyvek® ( ) PE Tyvek® ( ) Wetsuit ( ) Drysuit ( ) Other _____

HEAD/EYE/EAR: (X) Hard Hat (X) Safety Glasses ( ) Goggles ( ) Earplugs/Muffs ( ) Other _____

GLOVES: (X) Leather Work Gloves ( ) Neoprene ( ) PVC ( ) Vinyl (X) Other Nitrile _____

FOOTWEAR: (X) Safety-toe Leather ( ) Safety-toe Rubber (X) Overboots ( ) Snakeguards ( ) Other_____

Modifications Permitted: Neon Orange Safety Vest

Attachment D

Forms

Check one
Initial Report: ☐
Update: ☐
Final Report: ☐ ___

INCIDENT ANALYSIS REPORT
AMEC Environment & Infrastructure
Confidential - Privileged

Incident Potential
Letter: Select One
Number: Select One
Investigation Level: Select One

Group: Select One Group HSE Manager: ____ Incident Review Panel Team (if applicable): ____

Incident Date: _____ Report Date: _____

Section 1 – General Information

Employee Name: ____ Sex: ☐ M ☐ F Date of Birth: ____ Age Range: Select One

Job Position: Select One Hire Date: ____ Time employee began work: _____ Time of incident: ____ ☐ am | ☐ pm

Business Line: Select One Department Number: ____ Project Manager: ____

Project Name: ____ Project Number: ____ Client: ____

Office where employee works from: ____ Immediate Supervisor: ____ Hours employee worked during last 7 days: ____ hrs

Location: Select One Is this a Company controlled work site: ☐ Yes ☐ No Incident Assigned to: Select One

Location description: ____

Section 2 – Incident Type - Process (**mark at least ONE BOLD TYPE** and all that apply)

☐ **Fatality** ☐ **Environmental** ☐ **Injury/Illness Incident** If Injury/illness: Select One
☐ **Security** ☐ **Near Miss / Hazard ID** ☐ **Property Damage** If Damage: Select One ☐ 3rd Party?
☐ Hospitalization ☐ Regulatory Inspection ☐ Notice of Violation or Citation ☐ Agency Reportable?
☐ Motor Vehicle Incident Involving Injury ☐ Other (describe): ___

Outcome/Result: Select One Source of Hazard: Select One If "other", specify: ___ Immediate Cause: Select One

A. If **injury/illness**: Indicate the part of the body: Select One If "other", specify: ___
Indicate body part location: Select One If "other", specify: ___
Injury Type: Select One If "other", specify: ___ Illness Type: Select One If "other", specify: ___
B. If **property damage**: describe what happened and estimate ($) of damage to all objects involved? ___
C. If **environmental**: Type of Environmental incident?: Select One Name, CAS#, physical state and quantity? ___
Receiving Environment?: Select One Mechanism of Incident?: Select One If "other", specify: ___
Nature of Breach?: Select One Duration of Breach?: Select One
D. If **security**: Security Incident Type: Select One If Physical: Select One If Criminal: Select One If Intellectual: Select One
E. If an **inspection by a regulatory agency**, what agency, who were the inspectors, inspector contact information? ___

Section 3 – Incident Description

Attach and number additional pages, as needed, to ensure all details related to the incident are captured.

A. List the names of all persons involved in the incident, and employer information: ___
B. List the names of any witnesses, their employer, and a local/company telephone number or address: ___
C. Name of Employee's supervisor: ___ Contact phone number for supervisor: ___
D. What specific job/task or action was the employee(s) doing just prior to the incident: ___
E. Was a tool or equipment involved? ☐ Yes ☐ No What was it: ___ Last Inspection Date: ___Defects: ___
F. Explain in **detail** what happened: ___

G. Explain in **detail** what object or substance directly harmed the employee: ___

H. What were the weather conditions at time of incident?: ___

I. What was the lighting like at time of incident? Bright ☐ Shadows ☐ Dark ☐ Other: ___

J. List any damaged equipment or property (other than motor vehicles). Provide model and serial number **and** estimated costs to repair/replace damaged equipment or property, if applicable: ___

Section 4 - Incident Analysis

A. Was a Health and Safety Plan (HASP) or Activity Hazard Analysis (AHA) completed for the work being performed? ☐ Yes ☐ No
If "yes", Who prepared the document?: ___

B. Who and when was the last manager (Project, Unit, etc.) at the site of the incident?: ___

C. When and what safety training **directly related** to the incident has the person(s) involved had?: ___

D. List attached documentation (HASP acknowledgement forms, kickoff/daily/weekly meetings, inspections, photographs): ___

Section 5 - Incident Investigation Results and Corrective Actions

This section to be completed by the Group HSE Manager/IRP with support from location where incident occurred, in accordance with AMEC A-Z List of Accident Causes.

Causal Factors (Acts or Omissions / Conditions)

(Attach and number any additional pages as needed to completely address this section)

	IMMEDIATE CAUSE	IMMEDIATE CAUSE SUB-TYPE	DESCRIPTION
1	Select One	____	____
2	Select One	____	____
3	Select One	____	____
4	Select One	____	____

Root Cause(s) Analysis - The below items represents major root cause categories which have been determined to be Less Than Adequate (LTA). A more detailed determination of the root cause will be facilitated, if needed, by the applicable Group HSE Manager / IRP.

	ROOT CAUSE TYPE	ROOT CAUSE SUB-TYPE	DESCRIPTION
1	Select One	____	____
2	Select One	____	____
3	Select One	____	____

4	Select One	____	____

Corrective Actions

Root Cause #	Corrective Actions Taken (Attach additional pages as needed to completely address this section)	Responsible Person	Proposed Completion Date	Closed on Date	Verified by and Date Verified
____	___	___	___	___	___
____	___	___	___	___	___
____	___	___	___	___	___
____	___	___	___	___	___
____	___	___	___	___	___

Section 6 - Notifications, Certification & Approvals

Check the appropriate boxes indicating the applicable reports have been made to the following applicable organizations:

Auto Insurance Carrier was called ☐ **Group HSE Manager Notified ☐**

WorkCare was called ☐ **Post-incident Drug/Alcohol Testing Performed ☐**

Incident Report prepared by: ___

Employee (s): ___	Date: ___	Employee's Supervisor: ___	Date: ___
HSE Coordinator/Project/Unit Manager: ___	Date: ___	Group HSE Manager: ___	Date: ___

ATTACHMENT 2

VEHICLE INCIDENT REPORT

Confidential - Privileged

Section 1 - General Information

Date of Incident: Non-responsive

Time incident occurred: Unknown ☐ am | ☐ pm | Illumination: ☐ Dark ☐ Dusk ☐ Light | Road Condition: ☐ Dry ☐ Wet ☐ Icy/snow

Were police summoned to scene? ☐ Yes ☒ No Police Department and Location: _____

Report #; _____ Officer's Name: _____ Officer's Badge Number: _____

Section 2 - Company Driver and Vehicle

Driver's name: Non-responsive D/L #: Non-responsive State: Non-respo

Driver's home office address: Non-responsive Driver's Phone #: Non-responsive

Company Vehicle #: _____ Year: _____ Model: _____ License #: _____ State: _____

Company car?: ☐ Yes ☒ No Personal Vehicle?: ☐ Yes ☒ No Rental Vehicle?: ☒ Yes ☐ No

If rental, rented from: National

Passenger/Witness Name(s): _____ Address: _____ Telephone: _____

Passenger/Witness Name(s): Address: Telephone:

Non-responsive

Was an employee injured?: ☐ Yes ☒ No If yes, please describe: _____

Injuries to others?: ☐ Yes ☒ No If yes, please describe: _____

Vehicle was being used for: Company business ☒ Yes ☐ No Personal business ☐ Yes ☒ No

Towed?: ☐ Yes ☒ No If yes, by whom?: _____ To Where?: _____

Section 3 - Other Driver and Vehicle Information

Driver's Name: N/A D/L # : _____ State: _____

Current address: _____ City: _____ State: _____

Telephone: _____ Work: _____ Cell: _____

Registered Owner's Name: _____ Address: _____ City: _____ State: _____

(verify registration document)

The Other Vehicle: Make: _____ Model: _____ Year: _____ License #: _____ State: _____

Insurance company name: _____ Address: _____ Phone #: _____

Policy No.: _____ Contact Person: _____ Phone #: _____

Passenger/Witness Name(s): _____ Address: _____ Telephone: _____

Passenger/Witness Name(s): _____ Address: _____ Telephone: _____

Damage: (*Make note of pre-existing damage and take pictures if possible – you may attach additional pages if necessary):* _____

Injuries to other driver/passengers: _____

Section 4 – Approvals (signatures required)

Form completed by (please print): Non-responsive

Date: Non-responsive

Signature: _____

Office/Project Manager (please print): _____ Date: _____

Signature: _____

Things to Do First In The Event Of a Motor Vehicle Incident

GENERAL INFORMATION

1. Do not decide on your own whether a particular incident is "covered" by insurance. Should there be any doubt, it is always preferable to report an occurrence, as this allows underwriters, the Risk Management Department and insurance adjusters to determine if a covered loss has taken place.

2. Policy Conditions do require that all losses and occurrences, which may result in a claim be promptly reported.

3. Do not admit liability or offer your opinion of liability to anyone.

4. Complete this IAR/VIR form promptly and forward with all applicable supporting documentation. It is essential both division and location information be provided.

5. For automobile collisions within the **United States**, please indicate on the IAR form that you have contacted Zurich at:

Zurich Insurance Company
1-800-987-3373 or
1-877-928-4531
24 hours a day, 7 days a week

6. For automobile collisions within **Canada**, please indicate on the IAR form that you have contacted Zurich at:

Crawford Adjusters Canada
Claims Alert
1-888-218-2346
24 hours a day, 7 days a week

The more details you have the better but, don't delay reporting if you don't have all of the information - that may be obtained later. A Zurich trained operator will answer your call and ask for all relevant information regarding the incident. The initial information required includes:

- Your division,
- Office location and division contact name – advise that you are an AMEC Company
- Name, drivers license and phone number of the driver involved in the loss
- Description of the vehicle which he/she was driving (i.e., year, make, model, license plate number, serial number)
- Date, time and location of incident
- Passenger information (if applicable)
- Third party information (i.e., name, phone number, address, vehicle information, insurance information)
- If any injuries occurred (if applicable)
- Police information
- Witness information (if applicable)

Call 911 if there are serious injuries!

If you are injured or think you were injured, **contact your supervisor and call WorkCare at 888-449-7787**. Your supervisor will notify your HSE Coordinator and your Group HSE Manager. For additional instructions on what to do, go to AMEC's HSE website at:

http://ee.amecnet.com/she/sheweb/incident_reporting.htm

1. Call for an officer if the incident occurred on public property (streets, highways or roads). Disputes often arise between the parties involved as to who was at fault; therefore, a police report is important. If an officer is unable to attend the scene of the collision, a counter police report may be filed at most stations. Insurance companies rely on police reports to determine liability.
2. Complete the Incident Investigation Report and the Vehicle Incident Report forms. It is important that both these forms are completed in detail. Include a diagram of the incident on the provided sheet. Incomplete information may lead to delays in processing associated claims and in helping to prevent this type of incident from occurring again.
3. Give only information that is required by the authorities or as directed by AMEC contractual requirements.
4. Sign only those statements required by the authorities or as directed by AMEC contractual requirements. Do not sign away your or the company's rights.

Vehicle Incident Diagram

This or a similar diagram must be completed with all VIRs

MACTEC, Inc.

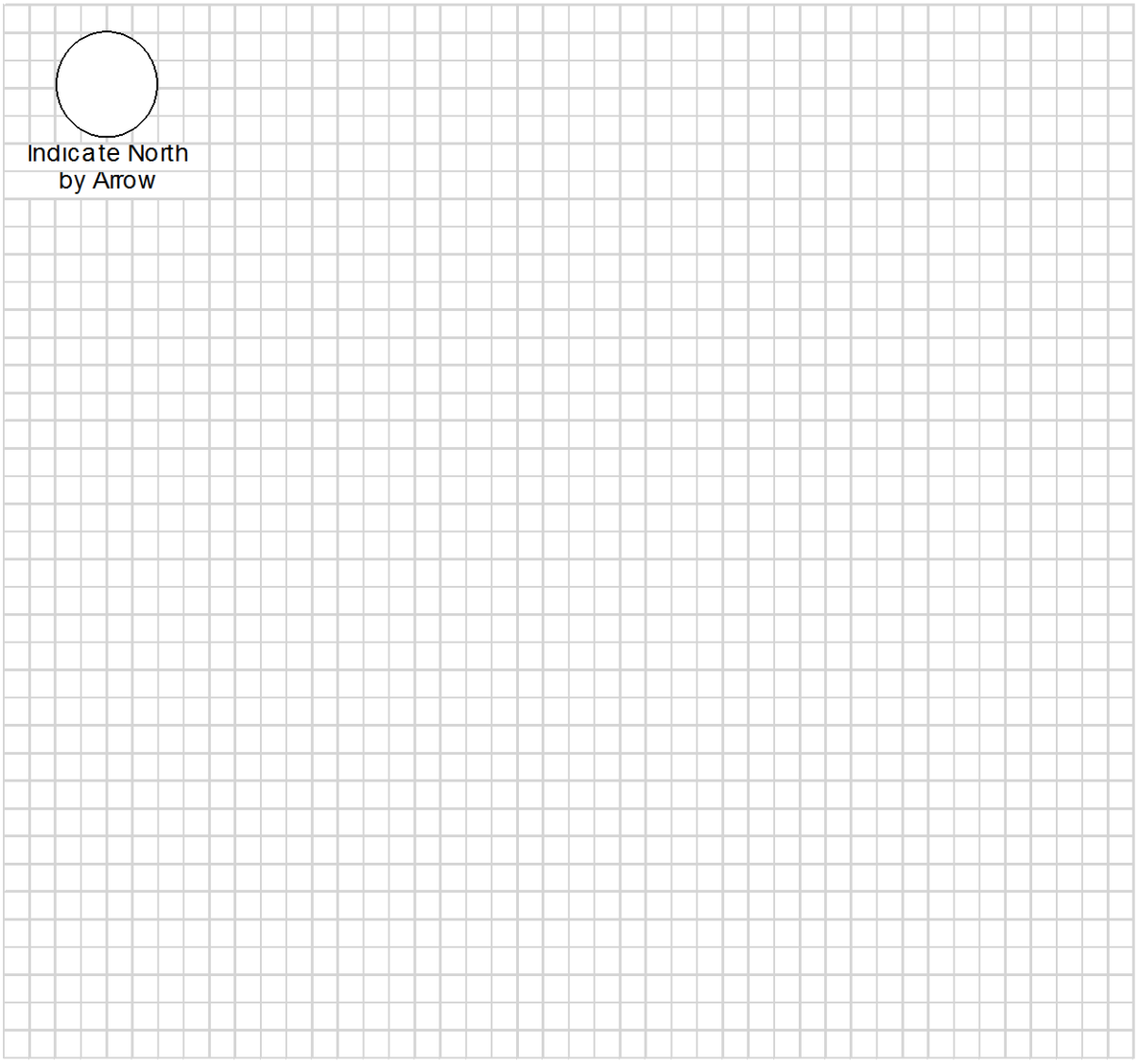
Vehicle Crash Diagram

Instructions:

1. Number each vehicle and show directions → [1] [2] ←
2. Use a solid line to show path before incident and use a dotted line to show path after incient

→ [1] (before) - - - - → [1] (after)

3. Show pedestrian/non-motorist by: ——→○
4. Show railroad by: +|+|+|+|+|+|+|+|+|+|+
5. Indicate north by arrow as: ⊘
6. Show street or highway names or numbers
7. Show signs, signals, warning and traffic controls.



Prepared by: _____ Date: _____

GROUND DISTURBANCE INCIDENT REPORT

AMEC Environment & Infrastructure

Section 1 – General Information

Employee Name: _____ Time of incident: _____ ☐ am | ☐ pm Time Reported:_____ ☐ am | ☐ pm Report Date: _____

Project Name: _____ Project Number: _____ Client: _____

List of All Parties Present

Name	Company	Telephone No.	Role
____	____	____	____
____	____	____	____
____	____	____	____
____	____	____	____
____	____	____	____

Describe the chronological description of Incident and response:____

Section 2 – Date and Location of Event

A. *Date of Event: (MM/DD/YYYY)

B. ***Country** ***State** ***County** **City**

C. **Street address** **Nearest Intersection**

D. *Right of Way where event occurred

E. Public: ☐ City Street ☐ State Highway ☐ County Road ☐ Interstate Highway ☐ Public-Other

F. Private: ☐ Private Business ☐ Private Land Owner ☐ Private Easement

G. ☐ Pipeline ☐ Power /Transmission Line ☐ Dedicated Public Utility Easement

☐ Federal Land ☐ Railroad ☐ Data not collected ☐ Unknown/Other

List attached documentation (Public Utility Locates, Private Utility Locates, Copy of notifications submitted to Owner or other utility Owners, photographs): _____

Section 3 – Affected Facility Information

***What type of facility operation was affected?**

☐ Cable Television ☐ Electric ☐ Natural Gas ☐ Liquid Pipeline ☐ Sewer (Sanitary Sewer)

☐ Steam ☐ Telecommunications ☐ Water ☐ Unknown/Other

***What type of facility was affected?**

☐ Distribution ☐ Gathering ☐ Service/Drop ☐ Transmission ☐ Unknown/Other

Was the facility part of a joint trench?

☐ Unknown ☐ Yes ☐ No

Was the facility owner a member of One-Call Center?

☐ Unknown ☐ Yes ☐ No

Section 4 – Excavation Information

***Type of Excavator**

☐ Contractor ☐ County ☐ Developer ☐ Farmer ☐ Municipality ☐ Occupant
☐ Railroad ☐ State ☐ Utility ☐ Data not collected ☐ Unknown/Other

***Type of Excavation Equipment**

☐ Auger ☐ Backhoe/Trackhoe ☐ Boring ☐ Drilling ☐ Directional Drilling
☐ Explosives ☐ Farm Equipment ☐ Grader/Scraper ☐ Hand Tools ☐ Milling Equipment
☐ Probing Device ☐ Trencher ☐ Vacuum Equipment ☐ Data Not Collected ☐ Unknown/Other

***Type of Work Performed**

☐ Agriculture ☐ Cable Television ☐ Curb/Sidewalk ☐ Bldg. Construction ☐ Bldg. Demolition
☐ Drainage ☐ Driveway ☐ Electric ☐ Engineering/Survey ☐ Fencing
☐ Grading ☐ Irrigation ☐ Landscaping ☐ Liquid Pipeline ☐ Milling
☐ Natural Gas ☐ Pole ☐ Public Transit Auth. ☐ Railroad Maint. ☐ Road Work
☐ Sewer (San/Storm) ☐ Site Development ☐ Steam ☐ Storm Drain/Culvert ☐ Street Light
☐ Telecommunication ☐ Traffic Signal ☐ Traffic Sign ☐ Water ☐ Waterway Improvement
☐ Data Not Collected ☐ Unknown/Other

Section 5 – Pre-Excavation Notification

***Was the One-Call Center notified?**

☐ Yes ☐ No If Yes, which One-Call Center? Ticket number:

Was Private Contract Locator used?

☐ Yes ☐ No

Section 6 – Locating and Marking

***Type of Locator**

☐ Utility Owner ☐ Contract Locator ☐ Data Not Collected

***Were facility marks visible in the area of excavation?**

☐ Yes ☐ No ☐ Data Not Collected

***Were facilities marked correctly?**

☐ Yes ☐ No ☐ Data Not Collected

What technology was used to locate utilities?

☐ Maps ☐ Active(transmitter+receiver) ☐ Passive (receiver only) ☐ GPR
☐ Acoustic ☐ Magnetic ☐ Infrared ☐ Unknown/Other

What Factors affected the ability to locate services?

☐ Soil Type:_____ ☐ Non-Grounded ☐ Common Bonded ☐ Depth
☐ Electromagnetic interference ☐ Parallel facilities ☐ Congested facilities ☐ Unknown/Other

Section 7 – Excavator Downtime

Did Excavator incur down time?

☐ Yes ☐ No

If yes, how much time?

☐ Unknown ☐ Less than 1 hour ☐ 1 hour ☐ 2 hours ☐ 3 or more hours Exact Value _____If

Estimated cost of down time?

☐ Unknown ☐ $0 ☐ $1 to 500 ☐ $501 to 1,000 ☐ $1,001 to 2,500 ☐ $2,501 to 5,000
☐ $5,001 to 25,000 ☐ $25,001 to 50,000 ☐ $50,001 and over Exact Value _____

Section 8 – Description of Damage

***Was there damage to a facility?**
☐ Yes ☐ No (i.e. near miss)
***Did the damage cause an interruption in service?**
☐ Yes ☐ No ☐ Data Not Collected ☐ Unknown/Other
If yes, duration of interruption
☐ Unknown ☐ Less than 1 hour ☐ 1 to 2 hrs ☐ 2 to 4 hrs ☐ 4 to 8 hrs ☐ 8 to 12 hrs ☐ 12 to 24 hrs
☐ 1 to 2 days ☐ 2 to 3 days ☐ 3 or more days ☐ Data Not Collected Exact Value _____
Approximately how many customers were affected?
☐ Unknown ☐ 0 ☐ 1 ☐ 2 to 10 ☐ 11 to 50 ☐ 51 or more Exact Value _____
Estimated cost of damage / repair/restoration
☐ Unknown ☐ $0 ☐ $1 to 500 ☐ $501 to 1,000 ☐ $1,001 to 2,500 ☐ $2,501 to 5,000
☐ $5,001 to 25,000 ☐ $25,001 to 50,000 ☐ $50,001 and over Exact Value _____
Number of people injured
☐ Unknown ☐ 0 ☐ 1 ☐ 2 to 9 ☐ 10 to 19 ☐ 20 to 49 ☐ 50 to 99
☐ 100 or more Exact Value _____
Number of fatalities
☐ Unknown ☐ 0 ☐ 1 ☐ 2 to 9 ☐ 10 to 19 ☐ 20 to 49 ☐ 50 to 99
☐ 100 or more Exact Value _____

Was there a Product Release?
Product Release: ☐ No ☐ Yes ☐ N/A Type: ____ **If Yes, Incident Type is Environmental Report.**
Volume: ____ Spill Controls: ____
Repair Process: ____

Section 9 – Description of the Root Cause

Please choose one

One-Call Notification Practices Not Sufficient
☐ No notification made to the One-Call Center
☐ Notification to one-call center made, but not sufficient
☐ Wrong information provided to One Call Center

Locating Practices Not Sufficient
☐ Facility could not be found or located
☐ Facility marking or location not sufficient
☐ Facility was not located or marked
☐ Incorrect facility records/maps

Excavation Practices Not Sufficient
☐ Failure to maintain marks
☐ Failure to support exposed facilities
☐ Failure to use hand tools where required
☐ Failure to test-hole (pot-hole)
☐ Improper backfilling practices
☐ Failure to maintain clearance
☐ Other insufficient excavation practices

Miscellaneous Root Causes
☐ One-Call Center error
☐ Abandoned facility
☐ Deteriorated facility
☐ Previous damage
☐ Data Not Collected
☐ Other

Section 10 - Notifications, Certification & Approvals

Check the appropriate boxes indicating the applicable reports have been made to the following applicable organizations:

One Call was called ☐ **Spills Reporting Agency Notified** ☐

Emergency Responders (Fire) was called ☐ **Post-incident Drug/Alcohol Testing Performed**

List of All Agencies Contacted

Name/Agency	Phone #	Date	Time

Incident Report prepared by: ____

Employee (s): ____	Date: ____	Employee's Supervisor: ____	Date: ____
HSE Coordinator/Project/Unit Manager: ____	Date: ____	Group HSE Manager:____	Date: ____

Record of Change
Site-Specific Health and Safety Plan

GENERAL SITE INFORMATION

Site Name: _____ Date: _____

Project Number: _____

Site Health and Safety Coordinator: _____

Project Manager: _____ Field Manager: _____

DESCRIPTION OF AND JUSTIFICATION FOR CHANGE

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

_____

SHSC Signature: _____ Date: _____

Authorization: _____ Title: _____ Date: _____

AMEC Earth & Environmental, Inc.
Tailgate Safety Meeting Report

Check One:

❑ Initial Kickoff Safety Meeting ❑ Regular/Daily Tailgate Safety Meeting ❑ Unscheduled Tailgate Safety Meeting

Date: _____ Site: _____

Field Manager: _____ Site Health and Safety Coordinator: _____
(print) *(print)*

Order of Business

Topics Discussed (check all that apply):

❑ Site History/Site Layout
❑ Scope of Work
❑ Personnel Responsibilities
❑ Medical Surveillance Requirements
❑ Training Requirements
❑ Safe Work Practices
❑ Logs, Reports, Recordkeeping
❑ Sanitation and Illumination
❑ Air Surveillance Type and Frequency
❑ Monitoring Instruments and Personal Monitoring
❑ Action Levels
❑ Accident Reporting Procedures
❑ Site Control (visitor access, buddy system, work zones, security, communications)
❑ Discussion of previous "near misses" including work crew suggestions to correct work practices to avoid similar occurrences
❑ Engineering Controls
❑ PPE Required/PPE Used
❑ Define PPE Levels, Donning, Doffing Procedures
❑ Physical Hazards and Controls (e.g., overhead utility lines)
❑ Decontamination Procedures for Personnel and Equipment
❑ General Emergency Procedures (e.g., locations of air horns and what 1 or 2 blasts indicate)
❑ Site/Regional Emergency Procedures (e.g., earthquake response, typhoon response, etc.)
❑ Medical Emergency Response Procedures (e.g., exposure control precautions, location of first aid kit, etc.)
❑ Hazardous Materials Spill Procedures
❑ Applicable SOPs (e.g., Hearing Conservation Program, Safe Driving, etc.)
❑ Injury/Illness Reporting Procedures
❑ Route to Hospital and Medical Care Provider Visit Guidelines
❑ Hazard Analysis of Work Tasks (chemical, physical, biological and energy health hazards and effects)

Safety suggestions by site workers: _____

_____

_____

Action taken on previous suggestions: _____

_____

_____

Injuries/accidents/personnel changes since previous meeting: _____

_____

_____

AMEC Earth & Environmental, Inc.
Tailgate Safety Meeting Report *(continued)*

Observations of unsafe work practices/conditions that have developed since previous meeting: _____

_____

_____

Location of (or changes in the locations of) evacuation routes/safe refuge areas: _____

_____

_____

Additional comments: _____

_____

_____

Attendee signatures below indicate acknowledgment of the information and willingness to abide by the procedures discussed during this safety meeting.

Name (print)	Company	Signature

Meeting conducted by: _____ Title: _____
(print)

Signature: _____ Time: _____

Site Air Surveillance Record

SITE INFORMATION		
Job Number:	**Date:**	**Site Location:**
Field Manager:	**Site Health and Safety Coordinator:**	

SITE CONDITIONS		
Temperature:	**Relative Humidity:**	**Wind Speed and Direction:**

Sample No.	Time	Sample Description	Location	Instrument	Reading	Comments

SITE VISITOR LOG					
NAME	SIGNATURE	COMPANY	DATE	ARRIVAL TIME	DEPARTURE TIME

Attachment E

SOPs

Bloodborne Pathogen Exposure Control Plan for Field Operations

1.0 PURPOSE

The purpose of this procedure is to provide AMEC Earth & Environmental, Inc. (AEE) personnel with the guidelines for action should personnel become exposed to bloodborne pathogens. All trained field personnel who administer first aid and/or cardiopulmonary resuscitation (CPR) to injuries involving blood or certain other body fluids have the potential of being exposed to bloodborne pathogens.

2.0 SCOPE

This procedure applies to AEE field personnel, personnel subcontracted to AEE, and visitors (including clients) of AEE who may work on or visit AEE jobsites.

3.0 DEFINITIONS

Bloodborne Pathogens - a disease-bearing microorganism that is transmitted via blood products from one person to another.

Universal Precautions - preventive measures that should be followed in all situations involving exposure to blood products, which assume that all human blood and certain human body fluids are infected with Human Immunodeficiency Virus (HIV), Hepatitis B Virus (HBV), and other bloodborne pathogens.

4.0 EXPOSURE RESPONSIBILITIES

Once an incident occurs, emergency actions must be followed for the safety of all responding personnel. It is the responsibility of the Project Manager (PM), Field Manager (FM), and Site Health and Safety Coordinator (SHSC) to ensure that this procedure is followed by all personnel.

All field personnel are responsible for implementing this procedure if responding to an incident involving first aid and blood or body fluid products. It is AEE policy to assume that all blood and other bodily fluids are infected with bloodborne pathogens; therefore, universal precautions must be employed.

4.1 Corporate Safety, Health, and Environment Director

It is the responsibility of the Corporate SHE Director to ensure that this procedure complies with Occupational Safety and Health Administration (OSHA) and applicable state guidelines, to review all injury/illness and First Aid Incident Reports, and to forward these documents to Human Resources. The regional SHE Manager is also responsible for informing the client of an incident requiring medical attention, in accordance with contractual agreements.

4.2 Field Manager

The FM is responsible for ensuring that all on-site personnel are familiar with this procedure and coordinating with the SHSC to ensure that all precautions are followed to prevent exposure to bloodborne pathogens.

In the event of a blood-bearing injury, the FM also ensures that all required reports are completed and submitted in a timely manner to the PM and Corporate SHE Director.

4.3 Project Manager

The PM is responsible for incorporating the requirements of this procedure into project plans, budgets, and activities, including appropriate first aid equipment. The PM is responsible for informing the Corporate SHE Director and client (as stipulated in the contract) of an incident requiring medical attention.

4.4 Site Health and Safety Coordinator

The SHSC is responsible for implementing and enforcing this procedure during project operations and activities. The SHSC will serve as a first responder in all first aid incidents and will coordinate with the FM to ensure that all precautions to prevent exposure to bloodborne pathogens are taken. When an incident occurs, the SHSC will immediately stop all work, follow universal precautions, and then attend to the injured party.

4.5 Subcontractors

All personnel subcontracted to AEE and working on a project are subject to the requirements of this procedure along with those specified by the subcontracting company.

5.0 PROCEDURE

This procedure details the steps required to coordinate and manage emergency action procedures in the event of a bloodborne pathogen incident. Both the SHSC and the FM must work together to ensure the safety of personnel.

5.1 Exposure Determination

AEE has not identified any existing job classifications or tasks where an occupational exposure would result from the performance of an employee's primary job duties. This exposure determination, however, would need to be modified in the event that an employee performs work on a site that contains biohazardous or medical waste.

Some employees have been identified as having collateral duties that could potentially involve an occupational exposure. These personnel include all employees performing work on field project sites. Tasks and procedures that, when performed, could involve an occupational exposure include:

- first aid response to a bleeding injury
- performing CPR or rescue breathing on an injured victim
- recipient to CPR, rescue breathing, or first aid
- performing cleanup at the site after treatment for a blood-bearing injury

5.2 Exposure Control

To control possible infection, responders to a bloodborne pathogen incident must follow the Center for Disease Control Universal Precautions. While rendering first aid where exposure to blood may occur, AEE employees must use designated personal protective equipment (PPE). This includes, at a minimum, latex or blue nitrile gloves. Protective gloves will be included in the field first aid kit in a bloodborne pathogen exposure control kit. Other items in the bloodborne pathogen exposure control kit that will help control the "spill" include absorbent beads, a plastic scooper, a biohazard (red) bag for waste, and towelettes for disinfecting surfaces and cleaning hands. For disinfecting larger surfaces, bottled bleach is recommended. In the event of a serious blood-bearing injury, safety glasses, Tyvek® coveralls, boot covers, protective outer gloves, and a one-way CPR mask will be available as PPE or in the first aid kit should the need arise. The one-way CPR mask is used for placement on an injured victim who requires rescue breathing or CPR to prevent direct contact between the rescuer and recipient.

5.3 Hepatitis B Virus Vaccination

First aid providers to job site injuries need not receive a pre-exposure HBV vaccine; however, all first aid providers assisting in any situation involving an exposure incident, must be offered the full Hepatitis B immunization series no later than 24 hours after an incident. Medical facilities that provide the immunization series are listed in the site-specific Health and Safety Plans (HSPs). Employees may refuse the HBV vaccination for any reason (religious, personal, or otherwise) by contacting the Corporate SHE Director or SHSC. Employees who refuse a recommended vaccine will be required to sign the Hepatitis B Virus (HBV) Vaccination Declination (Attachment 1) indicating refusal of the vaccination. The employee may elect to receive the vaccine in the future at no expense to him/her.

5.4 Exposure Incident Evaluation and Documentation

All first aid incidents involving exposure to blood or other body fluids must be reported to the Corporate SHE Director before the end of the work shift in which the incident occurs. A First Aid Incident Report (Attachment 2) describing the circumstances of the accident and response must be completed and submitted along with the Supervisor's Report of Injury or Illness form (Attachment 3). Each project will maintain an Accident/First Aid Incident Log (Attachment 4) documenting the potential exposure and precautions taken. In the event of an exposure, AEE shall arrange for a post-exposure evaluation. Employee monitoring for HIV or HBV antibodies and medical counseling in cases of positive tests for HIV or HBV will be provided through the local Medical Care Provider. A copy of the Healthcare Professional's Written Opinion (Attachment 5) will be provided to the employee within 15 days of completion of the evaluation.

5.5 Waste Disposal

Should biohazardous waste be generated as a result of a field-related injury, the "blood-bearing" waste and area will be cleaned to the extent possible with items in the bloodborne pathogen exposure control kit. Arrangements for the pickup and final disposal of the waste will be made by calling the designated biohazardous waste disposal contractor whose name, contact person, and phone number appear in the site-specific HSP.

The SHSC for each AEE project location shall determine applicable state disposal guidelines or quantity exemptions. In California, for example, the California Medical Waste Act has established a distinction between waste requiring disposal and waste that can be thrown in any garbage receptacle. Solid medical waste includes items such as bandages and gauze that are not saturated or caked with blood. Solid medical waste can be thrown in the garbage receptacle provided that the receptacle is in a locked, secure area. If a secure garbage area is not available, a 55-gallon drum may be used. Biohazardous waste includes needles and saturated bandages and gauze that, if wrung out, would drip blood. Biohazardous waste must be placed in a biohazardous (red) bag and disposed of by permit through a permitted waste hauler.

6.0 TRAINING

In accordance with OSHA requirements, all personnel will receive training in the control of bloodborne pathogens. Any first aid responders will have current certifications in approved first aid and CPR. Training frequencies are annually for bloodborne pathogens. Refer to Volume IV, Training Program, of this manual for a description of the training.

7.0 REPORTS

Where applicable, the following documents shall be retained as records:

- Hepatitis B Virus (HBV) Vaccination Declination
- First Aid Incident Report
- Supervisor's Report of Injury or Illness
- Accident/First Aid Incident Summary Log
- Healthcare Professional's Written Opinion

8.0 REFERENCES

1. Fed-OSHA. 2000. 29 CFR 1910.1030, *Bloodborne Pathogens*.
2. Cal-OSHA. 2000. 8 CCR 5193, *Bloodborne Pathogens*.
3. AMEC Corporate Health and Safety Manual, Volume V, Exposure Control Plan

Heat Stress Control

1.0 PURPOSE

The purpose of this procedure is to provide information on the causes, detection, prevention, and treatment of heat stress.

2.0 SCOPE

This procedure should be utilized by AMEC Earth & Environmental, Inc. (AEE) on-site personnel and subcontractors working on AEE field projects.

3.0 RESPONSIBILITIES

3.1 Site Health and Safety Coordinator/Project Manager/Field Manager

The Site Health and Safety Coordinator (SHSC) and Project Manager (PM) and/or Field Manager (FM) are responsible for implementing these procedures. Specific duties/responsibilities include:

- having knowledge about the signs and symptoms of heat stress
- ensuring appropriate time is allowed for acclimatization
- ensuring that employees practice appropriate heat stress prevention techniques
- completion of Heat Stress Monitoring form (Attachment 1) when conditions necessitate its use

3.2 Corporate Safety, Health, and Environment Director

The Corporate Safety, Health, and Environment Director (Corporate SHE Director) is responsible for auditing or evaluating on-site activities to ensure that these procedures are implemented.

4.0 PROCEDURES

4.1 Introduction

Heat is a physical stress on the human body. Exposure to excessive heat can develop into a serious health condition known as heat stress. If the proper measures are not taken to prevent or treat heat stress, the condition can become debilitating and perhaps fatal.

The two most likely sources of heat stress that could be encountered by AEE field personnel are (1) external heat produced by high air temperatures and humidity, and (2) heat generated from the human body that cannot dissipate. Protective garments can greatly hinder the body's mechanism of evaporative cooling, causing the body temperature to rise.

4.2 How the Body Handles Heat

Under moderate conditions of work and environmental heat, the brain regulates the body's temperature by monitoring the temperature of the blood. When the blood temperature rises above 98.6 degrees Fahrenheit (°F), the body initiates heat control mechanisms. The two major mechanisms of thermoregulation are increased blood flow and sweating.

4.2.1 Increased Blood Flow

As the heart begins to pump more blood towards the skin, excess body heat is lost to the air through convection, radiation, evaporation, and conduction depending on air temperature, humidity, and air movement.

Convection

Convection is the transfer of heat by movement of the thin layer of insulating air next to the skin. Air movement causes a cooling action. The absence of wind will cause a more intense heat effect.

Radiation

Radiation is the transfer of heat to cooler objects in the surrounding environment. The heat is transferred through space between objects that are not in direct contact with each other. For example, the heat from a broiler will warm objects in its surrounding area. In the same way, the body's heat will transfer to a cooler environment or will warm in the presence of a hotter environment.

Evaporation

Evaporation is the absorption of moisture into the air. Evaporation of moisture from the skin cools the body. The rate of this evaporative cooling is significantly increased by convection or air movement across wet skin and/or wet clothing. The amount of evaporation is also increased by low humidity. When humidity is high, evaporation is hindered and the heat hazard increases.

Conduction

Conduction is the transfer of heat between objects that are in contact with each other. For example, touching a piece of metal that is hotter than skin temperature will conduct heat toward the body.

4.2.2 Sweating

When heat loss by increased blood flow is not enough to keep the body core temperature normal, the brain signals the sweat glands in the skin to begin producing sweat (mixture of water and salts). The sweat evaporates on the skin and cools the skin surface. Sweating does nothing to cool the body unless the sweat can evaporate from the skin. When humidity is high, evaporation of perspiration slows down or stops. As the heart labors to pump more and more blood to the surface and the sweat glands continue to pour liquids onto the skin surface, the production of internal body heat continues. If this condition is not dealt with at this stage, heat stress disorders can arise rapidly.

As more blood flows to the skin, less blood remains to supply the active muscles. Strength declines and fatigue may come sooner than it would otherwise. Behavioral changes can arise in the forms of reduced accuracy, comprehension, and retention. In addition to these physiological changes, certain safety problems commonly arise in hot environments:

- sweaty palms resulting in impaired functional ability
- dizziness
- fogging of safety eyewear
- possible burns from accidental contact with hot surfaces

4.3 Monitoring the Hot Work Environment

There are two commonly recognized methods to measure the working conditions for heat hazard. One method employs measuring the actual environment for important physical parameters. The other monitoring technique, often used in tandem with environmental monitoring, is personal monitoring.

4.3.1 Environmental Monitoring

Evaluating the work environment to determine the degree of heat stress involves measuring and recording four different physical factors:

- air temperature
- humidity
- radiant temperature
- air speed

Many different ways have been devised to evaluate the above-mentioned parameters. The method recognized by the American Conference of Governmental Industrial Hygienists (ACGIH) is commonly known as Wet Bulb Globe Temperature (WBGT). WBGT values are calculated based on the following equations:

(1) Outdoors with solar load

$$WBGT = 0.7\ (WB) + 0.2\ (GT) + 0.1\ (DB)$$

(2) Indoors or Outdoors with no solar load

$$WBGT = 0.7\ (WB) + 0.3\ (GT)$$

WBGT = Wet Bulb Globe Temperature Index
WB = Natural Wet-Bulb Temperature
DB = Dry-Bulb Temperature
GT = Globe Temperature

NOTE: Temperatures can be recorded in either °F or °C (degrees Centigrade), but must be used consistently throughout the equation.

These measurements are made using specialized heat stress measuring equipment that measures each of the temperature parameters of the equation above. Instruments that measure the various temperature parameters, as well as calculate the WBGT for the user, are also available. To obtain the equipment, contact a manufacturer (e.g., Metrosonics, Inc.) or a local instrument rental company. The monitoring should be made by an industrial hygienist or an appropriately trained SHSC who is familiar with the instruments and work being performed. Measurements are recorded on the Heat Stress Monitoring Form (Attachment 1).

The recommended ACGIH Screening Criteria for Heat Stress Exposure are presented in Attachment 2.

4.3.2 Personal Monitoring

Individuals vary in their susceptibility to heat stress. Factors that may predispose an individual to heat stress include:

- lack of physical fitness
- alcohol and drug use

- lack of acclimatization
- infection
- age
- sunburn
- dehydration
- diarrhea
- obesity
- chronic disease

When workers must wear semipermeable or impermeable encapsulating personal protective garments the ACGIH recommended Threshold Limit Values (TLVs) cannot be used. For these situations, employees should be monitored when the temperature in the work area is above 70°F (21°C). When impermeable clothing will be worn, exposure limits will be established by applying adjustment factors to the values in Attachment 2. Adjustment factors are as follows:

WBGT Correction Factor* (˚C)

Summer work uniform[1] 0
Coveralls 2
Kleenguard coveralls 4
Standard Tyvek 6
Tyvek, PE 7
Encapsulating suit 11

* Subtract correction factor (°C) from the WBGT in Attachment 2.
[1] Summer work uniform is cotton long pants and cotton tee shirt.

To monitor an employee for heat stress, one can measure any of the following parameters:

• Heart rate. Count the radial pulse during a 30-second period as early as possible in the rest period.

If the heart rate exceeds 110 beats per minute (bpm) at 1 minute into the rest period, shorten the next work cycle by one-third and keep the rest period the same duration.

If the heart rate still exceeds 110 bpm at 1 minute into the next rest period, shorten the following work cycle by one-third.

If the heart rate exceeds 120 bpm at 1 minute into the rest period, the worker is under a significant strain and risk and the worker should be removed from the shift until his/her heart rate returns to normal.

• Oral temperature. Use a clinical thermometer (3 minutes under the tongue) or similar device to measure the oral temperature at the start and end of the work period. To obtain accurate results, workers shall not eat or drink for 15 minutes prior to oral temperature monitoring. There shall be no talking or mouth breathing when the thermometer is measuring the temperature.

If oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period duration.

If oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third.

Do *not* permit a worker to wear a semipermeable or impermeable garment when his/her oral temperature exceeds 100.6°F (38.1°C).

• Body water loss, if possible. Measure weight on a scale accurate to ± 0.25 pound (lb) at the beginning and end of each workday to see if enough fluids are being taken to prevent dehydration. Weights should be taken while the employee wears similar work clothing. If the change in body weight divided by the body weight, when multiplied by 100, exceeds 1.5 then there is likely dehydration. *The body water loss should not exceed 1.5 percent total body weight in a workday.*

• Behavior. Other indications of heat stress may be recognized from worker behaviors that include:

- adjusting clothing
- slowing down
- increased number of mini-breaks
- irritability
- low morale
- absenteeism
- increased number of errors
- shortcuts in maintenance

The SHSC should monitor personnel for these changes in worker behavior.

4.4 Heat Illnesses

Table 1 provides a description of the common heat stress illnesses, symptoms, underlying causes, and treatment.

4.5 Preventing Heat Stress

Heat stress can be prevented by taking personal protective measures, such as allowing for acclimatization, ensuring fluid replacement, satisfying the body's salt requirements, modifying work practices, and other control measures.

4.5.1 Acclimatization

The human body has a dramatic adaptation mechanism for working in the heat called acclimatization. Any unprepared employee when exposed for the first time to a hot work environment will develop signs of significant strain such as elevated body temperature, pounding heart, high pulse rate, and sweating. But the body will, over a series of days spent working in the heat, make a series of adjustments. These adjustments, which include the decreasing of body temperature and pulse rate, will occur after the individual has worked in the heat for a week for at least 2 hours per day.

After acclimatization has taken place, work in the heat can be performed with a major reduction in strain. This allows the employee to work more effectively under conditions that may have been intolerable before acclimatization.

An important point to emphasize - acclimatization will not take place if workers do not drink enough water to replace body fluids lost to sweating. Also, acclimatization is gradually lost if work in heat stops. Some degree of acclimatization is lost over a weekend and a large degree would be lost over a full week. It is significant to remember that when employees are first exposed to the heat, or when they are returning from time off such as vacation, the workload should be reduced until acclimatization can occur.

4.5.2 Fluid Replacement

Employees must be encouraged to drink enough fluid to replace the fluid that is lost through sweating. Employees should be told to drink often throughout the day. Fluid replacement should occur at 20-minute

intervals and coincide with cool-down breaks. Workers should begin the day with 16 ounces (2 cups) of water or electrolyte replacement fluids and then about 8 ounces (1 cup) every break. Cool water (about 10 to 15°C) is the ideal replacement fluid. Employees who are sweating heavily must be encouraged to drink large amounts of water every 20 to 30 minutes whether they are thirsty or not. Thirst is a poor indicator under these conditions because by the time thirst is felt, heat stress already exists. Intermediate decon (as defined in the Decontamination Procedures section of the hazardous waste site-specific Health and Safety Plan [HSP]) may be performed for short heat stress mitigation breaks on hazardous waste sites.

Table 1
Heat Stress Illnesses

Heat Illness	Description	Symptoms	Possible Underlying Causes	Treatment
Heat Cramps	Spasms in voluntary muscles due to reduction in the concentration of sodium chloride with continued loss of salt in sweat and copious intake of water without appropriate salt replacement. Other electrolytes, such as magnesium, calcium, and potassium may also be involved.	Painful spasms of muscles used during work. May occur during or after work hours.	Drinking large quantities of water without replacing salt loss Excessive perspiration during hot work	Administer lightly salted water by mouth unless on medical restriction. Consult physician. Adequate salt intake with meals. Those on salt-restricted diets should consult their physician for guidance. Do not follow fad or restrictive diets while working in heat conditions except under physician's advice.
Heat Syncope	Pooling of blood in dilated vessels of skin and lower parts of body	Fainting while standing erect and immobile in the heat	Lack of acclimatization	Remove to cooler area Recovery should be prompt and complete Consult physician
Dehydration	Excessive loss of body water	No early symptoms Fatigue/weakness Dry mouth	Excessive fluid loss due to sweating Excessive fluid loss due to illness (such as vomiting or diarrhea)	Remove to cool area Fluid replacement

		Loss of work capacity Increased response time	Excessive fluid loss due to alcohol consumption	
Heat Rash (Prickly Heat)	Keratinous layers of skin absorb water, swell, and mechanically obstruct the sweat ducts	Profuse, tiny, raised, red vesicles (blister-like), usually in areas where clothing is restrictive Prickling sensation during heat exposure, particularly as sweating increases	Occurs on skin that is persistently wetted by unevaporated sweat Plugging of sweat gland ducts with retention of sweat and inflammatory reaction	Clean, cotton garments against the skin Mild drying lotions Skin cleanliness to prevent infection
Heat Exhaustion	Low arterial blood pressure caused partly from inadequate cardiac output and partly from widespread vasodilation	Skin clammy and moist, profuse sweating, coloring pale or muddy Extreme fatigue, weakness, blurred vision, dizziness, nausea, headache or light-headedness Insecure gait, may faint while standing Exhibits rapid pulse and low blood pressure Oral temperature normal or low, rectal temperature may be elevated to 99^{o}F to 101^{o}F	Lack of acclimatization/fitness Continuous exertion in heat Failure to replace water/salt lost in sweat, or from gastrointestinal maladies (dehydration) Distribution of blood to the periphery	Remove to cooler area Administer fluids by mouth (if victim is conscious) or give intravenous infusions of normal saline (should be done under care of a physician, especially for those on medically restricted diets)
Heat Stroke	Failure of the thermoregulating system	Chills; hot, dry skin; red, mottled or bluish High, rising deep body (core)	Continuous exertion in heat by unacclimatized employees Lack of	Call emergency medical services for assistance. Inform ambulance on telephone that heat illness

		temperature: 104°F and over Mental confusion, restlessness, irritability, belligerence, loss of consciousness, convulsions or coma as temperature rises	acclimatization Obesity Recent alcohol consumption Dehydration Individual workers' susceptibility Chronic cardiovascular disease	emergency exists. Danger - Fatal if treatment is delayed. Cool body while awaiting ambulance. Immediate cooling of victim by immersion in chilled water Wrapping victim in wet sheet while fanning with cool, dry air Sponging with cool liquid and fanning Treat shock, if necessary

4.5.3 Salt Requirements

Sweat contains water, salt, and other electrolytes. The body needs a certain amount of salts to function properly, but using salt tablets is not recommended. Salt tablets cause stomach irritation that may result in nausea and vomiting.

Presently, it is recommended that drinking water for employees not be salted, because the normal diet should provide adequate salt intake. However, if heat cramps are observed, slightly salted water (0.1% or 1 teaspoon of salt/15 quarts water) or an electrolyte replacement fluid (e.g., Gatorade™) should be provided. Caution should be taken by individuals with high blood pressure or on a sodium-restricted diet.

4.5.4 Work Practices

Preventive work practices can be used as either an alternative or complementary approach to engineering controls for preventing heat stress. Preventive practices may include:

- limiting or modifying the duration of exposure time
- building the heat tolerance of the worker by heat acclimatization and physical conditioning
- establishing a work-rest regimen that provides adequate rest periods for cool down
- training workers in safety and health procedures for work in hot environments

The following are ways to control the daily length of time and temperature to which a worker is exposed in heat stress conditions:

- schedule hot jobs for cooler parts of the day
- schedule routine maintenance, repair work, and field projects in hot areas for the cooler seasons of the year
- alter the work-rest regimen to permit more rest time (the initial work period for an acclimatized worker should not exceed 1 to 1.5 hours, followed by a cool down of at least 15 minutes)
- • provide cool, shaded areas for rest and recovery during the work shift
- • add extra personnel to reduce exposure time for each member of the work crew
- • permit freedom to interrupt work when a worker feels extreme heat discomfort

The heat tolerance of workers can be enhanced in the following ways:

- establish an appropriate heat-acclimatization program
- instruct employees to gradually increase the thermostat in sleeping quarters for off-duty hours so that daily adjustment to the temperature at the project site is made easier
- encourage workers to achieve and maintain physical fitness
- ensure that an adequate supply of water is taken (roughly 8 ounces every 20 minutes)
- maintain the electrolyte balance in the body fluids

A work-rest regimen that provides adequate periods for cool down should be established. Work-rest periods will be adjusted based on the condition of the heat-exposed worker. When impermeable protective garments are worn, they will be removed during the cool-down period to allow for adequate recovery. Breaks shall be taken in a shaded, cool rest area (77°F or lower is best).

4.5.5 Training

Workers will be trained in accordance with Volume IV, Training Program, of this manual in health and safety procedures for work in hot environments. Such workers will be familiar with the preventive measures outlined in Volume II, Comprehensive Field Project Health and Safety Program, of this manual and in the site-specific HSP (when applicable), as well as early recognition of the signs and symptoms of heat illnesses and initiation of first aid and corrective procedures. Training topics will include:

- signs and symptoms of heat-induced illnesses
- causes and recognition of heat illnesses
- work practices to minimize heat illnesses
- proper care and use of heat protective clothing and equipment
- effects of nonoccupational factors (such as drugs, alcohol, and obesity) on tolerance to occupational heat stress
- buddy system designed to recognize the early signs and symptoms of heat illnesses

4.5.6 Additional Control Measures

<u>Engineering Controls</u>

Engineering controls are measures that may be used to reduce the stress of a hot environment. They include, but are not limited to:

- use of increased general ventilation or spot cooling to reduce temperatures in the work location
- use of local exhaust ventilation at points of high heat production to remove large quantities of generated and/or latent heat from the work area
- use of large fans to increase the air velocity over the workers and thereby increase the evaporative heat loss (Caution: if air temperature is greater than 95˚F, the use of fans will increase the heat stress. Cool the air instead being careful to avoid causing drafts that will disturb any existing exhaust ventilation controls)
- Application of radiant heat shielding may be helpful by such methods as:

    - insulating heat-producing equipment
    - covering exposed body parts with clothing
    - using reflective screens (made up of material such as polished aluminum, tin, or zinc) placed between the worker and the radiant heat source to reflect the heat back to the source
    - wearing reflective aprons or reflective clothing (especially useful when the workers face the heat source)

- elimination of steam leaks, by hooding or covering of steaming tanks, hot water drains, etc., to reduce the water vapor pressure at the work site
- isolation, relocation, redesign, or substitution of equipment and/or processes to reduce the thermal stress at the work site
- a wider use of work-saving devices (such as power tools, hoists, cranes, or other lifting aids) to reduce the metabolic workload
- as feasible, provisions for field "showers" or hose-down areas to cool the body down

Administrative Controls

Administrative work practice controls are most easily implemented and include any and all work practices or rules that may reduce the total heat stress burden. Included are:

- acclimatization to the heat
- work-rest schedule designed to reduce peaks of heat stress
- enforcing scheduled rest breaks
- if possible, providing air-conditioned rest areas to give rapid recovery (this practice decreases the cumulative effects of heat exposure)
- enforcing a schedule of frequent water ingestion breaks and provision of abundant, cool drinking water or electrolyte replacement fluids
- scheduling the hottest work for the coolest parts of the day
- where possible, moving work indoors or to air-conditioned or cooler areas
- assigning extra workers to highly demanding tasks to reduce the individuals' metabolic loads
- allowing employees to pace themselves and take frequent rest breaks
- rotating duties for hot jobs
- enforcing the buddy system
- educating workers on the basic principles of preventing heat stress illnesses and on emergency response to heat illness
- cooling sleeping quarters to allow skin to dry between heat exposures

Personal Protective Equipment

Personal protective equipment (PPE) includes a wide range of items such as ordinary work clothing, liquid cooling systems, ice-cooled body suits, and reflective clothing for radiant heat. The correct clothing depends upon the specific heat stress situation. The HSP will identify appropriate garments for heat stress management.

Where air temperature is higher than the skin temperature or there is radiant heat (e.g., from a furnace or the sun), then clothing will protect the body. The advantage of wearing clothing, however, is negated if the clothes interfere too much with the evaporation of sweat, which is a vital cooling function.

Clothes made of thin cotton fabric help evaporate sweat by picking it up and bringing it to the surface. Nonbinding clothes are also good for sweat evaporation. In contrast, tightly fitting clothes made of synthetic fabrics interfere with evaporation.

4.6 Control Measures for Heat Stress

A summary of heat stress control measures includes the following:

- Medical supervision of workers including preplacement physicals that evaluate fitness, weight, cardiovascular system and other conditions that may make an individual susceptible to heat illnesses. Medical evaluation during and after heat illnesses and medical release for returning to work should also be included.
- Employee training and education on heat stress, heat-induced illnesses and their symptoms, water and salt replacement, clothing, work practices, and emergency first aid procedures.
- Acclimatization of employees for work in the heat.
- Work-rest regimens with air-conditioned rest areas and enforced rest breaks.
- Provision of cool, plentiful water supplies or electrolyte replacement fluids and scheduled rehydration breaks. Employees should be encouraged to weigh themselves daily to avoid dehydration.
- Environmental monitoring using one of the heat stress indices to determine the heat load and adjust work-rest regiments accordingly.
- Forecast of episodes of extreme heat or heat spells whereupon a number of preventive practices would be initiated.
- Reduction of heat stress by the proper use of engineering controls, administrative controls, or PPE.

5.0 RECORDS

Ambient temperature records and heat stress mitigation methods shall be recorded on the Heat Stress Monitoring Form (Attachment 1) by the SHSC or designee.

6.0 References

1. National Safety Council. 1985. *Pocket Guide to Heat Stress*.
2. American Conference of Governmental Industrial Hygienists. *Threshold Limit Values and Biological Exposure Indices for 2001*.
3. National Safety Council. 1988. *Fundamentals of Industrial Hygiene*. 3rd Edition.
4. Patty, F.A. 1991. *Patty's Industrial Hygiene and Toxicology, General Principles*. Edited by George D. Clayton and Florence E. Clayton. Vol. I, Part A. 4th Edition. New York: Wiley and Sons, Inc.

Cold Stress Control

1.0 PURPOSE

The purpose of this procedure is to provide information on the causes, detection, prevention, and treatment of cold stress.

2.0 SCOPE

This procedure should be utilized by all AMEC Earth & Environmental, Inc. (AEE) on-site personnel and subcontractors working on AEE field projects where cold stress poses a hazard.

3.0 RESPONSIBILITIES

3.1 Site Health and Safety Coordinator/Project Manager

The Site Health and Safety Coordinator (SHSC) and Project Manager (PM) are responsible for implementing these procedures.

3.2 Corporate Safety, Health, and Environment Director

The Corporate Safety, Health, and Environment Director (Corporate SHE Director) is responsible for auditing or evaluating on-site activities to ensure that these procedures are implemented.

4.0 PROCEDURES

4.1 Introduction

A cold environment can reduce the temperature of the body and cause shivering, reduced mental alertness, and sometimes even loss of consciousness. Cold can cause adverse effects before a problem is even realized.

When properly protected, a healthy worker can function efficiently and safely in both natural and man-made cold environments.

Cool conditions, especially with high winds, cold water, convection, conduction, and evaporation, are sources of cold that can affect workers.

The effects of cold on the body depend on how well the skin is insulated from the environment. This insulating barrier determines the rate of heat loss from the body by radiation, convection, conduction, and evaporation.

Any combination of low temperature and air movement will have a cooling effect on the body. The faster the air movement, the greater the effect. These environmental factors determine the rate at which the body cools by giving off or exchanging heat with the surrounding environment.

4.2 How the Body Loses Heat

Conduction, convection, evaporation, and radiation are means by which the body loses heat.

4.2.1 Conduction

Conduction is the transfer of heat between objects that are in contact with each other. For example, touching a piece of metal that is cooler than skin temperature will conduct heat away from the body.

4.2.2 Convection

Convection is the transfer of heat by movement of the thin layer of insulating air next to the skin. The air movement causes a cooling action. The stronger the wind, the more intense the cold effect will be. A strong current of air will blow the insulating air away and intensify the cold effect. A good example of how convection works is the familiar wind chill factor. A calm day with a temperature of 20 degrees Fahrenheit (°F) will feel cold. But if you add a 30-mile-per-hour wind to that same temperature, the day will feel bitterly cold (equivalent to about -18°F). For more specific information on the cooling power of wind, see the table in Attachment 1.

4.2.3 Evaporation

Evaporation is the absorption of moisture into the air. Evaporation of moisture from the skin cools the body. The rate of this evaporative cooling is significantly increased by convection or air movement across wet skin and/or wet clothing. The amount of evaporation is also increased by low humidity.

4.2.4 Radiation

Radiation is the transfer of heat to cooler objects in the surrounding environment. The heat is transferred through space between objects that are not in direct contact with each other. For example, the heat from a broiler will warm objects in its surrounding area. In the same way, the body's heat will transfer to a cooler environment.

When conduction, convection, evaporation, radiation, cold air temperatures, or fast air movement occur, the hazard of cold stress illness is present.

4.3 How the Body Handles Cold

The human body is designed to function best at a constant temperature of approximately 98.6^{o}F. The body does this by gaining heat from food and muscular work, or by losing it through radiation and sweating. The body's first physiological defense against cold is constriction of the blood vessels of the skin and/or shivering.

Cold first affects the skin. The chilled blood circulates and the body begins two processes - one to conserve heat already in the body, the other to generate new heat.

4.3.1 Constriction of Peripheral Blood Vessels

Heat conservation is accomplished by causing outer blood vessels to constrict, which reduces the heat loss from the surface of the skin and makes the outer area an insulator. This constriction also inhibits the function of the sweat glands, preventing heat loss by evaporation.

If someone becomes fatigued during physical activity, he or she will be more prone to heat loss. As exhaustion approaches, sudden enlargement of the blood vessels can occur, resulting in rapid loss of heat.

4.3.2 Blood Thickening

When it becomes necessary for the body to conserve heat, the kidneys are stimulated to produce about three times the normal amount of urine, which increases the oxygen level of the blood and reduces both the water and salt levels in the body. As a result, the blood becomes thicker and cannot reach the blood vessels near the skin, which makes more of the oxygen in the blood available as fuel for the muscles to generate heat and energy.

4.3.3 Increased Heart Rate and Glucose Production

The body produces glucose (blood sugar) to provide additional fuel. The heart also begins to beat faster, which sends oxygen- and glucose-rich blood to the muscles and organs where they are needed.

4.3.4 Involuntary Shivering

Involuntary shivering begins in an attempt to produce more heat by rapid contractions of the muscles, much as heat is generated by strenuous activity. Shivering raises the body's metabolic rate. As the metabolic rate increases, the appetite increases, usually followed by calorie intake (eating), which pours "fuel" into the body's "furnace."

4.4 The Safety Effects of Cold Stress

The frequency of accidents seems to be higher in cold environments. Nerve impulses are slowed and we react more sluggishly, fumble with our hands, and become clumsy. Additional clothing and gloves may hinder movement. There are also safety problems common to cold environments. They include ice or snow blindness, reflections from snow interfering with vision, and the possibility of burns from contact with cold metal surfaces.

4.5 Monitoring the Cold Environment

Common sense should dictate how much clothing to wear and when to get into a warm area in most cases. However, some work environments require more complex evaluation.

Evaluating a work environment to determine the degree of cold stress involves measuring:

- air temperature
- wind speed
- the amount of energy expended by the workers

Air temperature can be measured by an ordinary bulb thermometer. Wind speed is measured by a device called a thermoanemometer, which senses and measures air motion by the rate of cooling of a hot wire at the tip of a probe.

The Threshold Limit Value (TLV), published by the American Conference of Governmental Industrial Hygienists (ACGIH) states that the deep body core temperature should be prevented from falling below 98.6°F. For a single, occasional exposure to a cold environment, a drop in core temperature to no lower than 95°F should be permitted. The ACGIH Chill Temperature Chart relating dry bulb air temperature and wind velocity is presented in the table in Attachment 1. The recommended ACGIH TLVs for properly clothed workers for periods of work at temperatures below freezing are shown in the table in Attachment 2. TLVs are intended to protect workers from the severest effects of cold stress and to prevent injury to body extremities.

Workplace monitoring is required as follows:

- Suitable temperature measurements should be conducted at any workplace where the environment temperature is below 16 degrees Centigrade (°C) (60.8°F) so that overall compliance with the requirements of the TLV can be maintained.
- Whenever the air temperature at a workplace falls below -1°C (30.2°F), the dry bulb temperature should be measured and recorded at least every 4 hours.
- The wind speed should also be recorded at least every 4 hours whenever the rate of air movement exceeds 2 meters per second (5 miles per hour). Contact the local meteorological station (e.g., local airport) for wind speed and direction data.
- In outdoor work situations, the wind speed should be measured and recorded together with the air temperature whenever the air temperature is below -1°C (30.2°F).
- The equivalent chill temperature should be obtained from the table in Attachment 1 in all cases where air movement measurements are required; it should be recorded whenever the equivalent chill temperature is below -7°C (19.4°F).

Employees are excluded from work in cold at -1°C (30.2°F) or below if they are suffering from diseases or taking medication that interferes with normal body temperature regulation or reduces tolerance to work in cold environments. Workers who are routinely exposed to temperatures below -24°C (-11.2°F) with wind speeds less than 5 miles per hour, or air temperatures below -18°C (0°F) with wind speeds above 5 miles per hour, shall be medically certified as suitable for such exposures.

4.6 Cold Disorders

The main factors contributing to cold injury are exposure to humidity and high winds, contact with wetness or metal, inadequate clothing, age, and general health. Physical conditions that worsen the effects of cold are allergies, vascular disease, excessive smoking and drinking, and specific drugs and medicines. For a quick reference of cold illnesses, symptoms, possible underlying causes, and treatment, see Table 1.

4.7 First Aid Treatment

4.7.1 First Aid Procedures for Hypothermia

The main objective in treating hypothermia is rewarming the body core evenly and without delay. However, doing it too rapidly can further disrupt body functions, such as circulation. If medical help is not immediately available, the first thing to do is get the victim out of the wind, snow, or rain. Keep the victim's use of energy to a minimum, but keep him or her awake, if possible. Get the victim into dry clothes and wrap a blanket, sleeping bag, or newspapers around him or her. Avoid any unnecessary movement of the victim.

In a case of mild hypothermia, where the victim is conscious, the body may be packed with heat packs on wet towels - no warmer than 105°F - behind the neck, at the groin, and in the armpits. Give sweet, warm, caffeine-free, nonalcoholic drinks to conscious victims. Do not rewarm the extremities and the core at the same time. The sudden return of the cool blood pooled in the extremities to the heart can produce a drop in core temperature and cause shock.

As much as possible, try to avoid moving, because a hypothermia victim's exertion from walking could aggravate circulation problems.

All victims of hypothermia should receive professional medical treatment. Active rewarming without appropriate medical support could be hazardous to the victims.

Provide lifesaving actions as necessary - mouth-to-mouth resuscitation or cardiopulmonary resuscitation (CPR), if you are trained to do so. A hypothermia victim should never be given up for dead in the field. Many hypothermia victims unconscious for several minutes have been fully revived with minimal damage.

4.7.2 First Aid Procedures for Frostbite

First aid for frostbite is designed to prevent further tissue damage by warming the affected area rapidly and maintaining respiration. Accepted procedures are listed under Attachment 3, "Cold Illnesses."

Very minor frostbite of the outer layer of skin should be treated as soon as possible in the field. Deep frostbite should not be thawed in the field, or there is a possibility that the thawed tissue will refreeze. Thawed tissue will have impaired circulation and will be more susceptible to refreezing, infection, and tissue death. Freezing preserves tissues, so severe frostbite is best left in a frozen state until proper medical attention can be obtained. Protect the frozen area from additional injury.

Do not try to rewarm frostbitten areas by rubbing, exercise, exposure to open fires, cold water soaks, or rubbing with snow. This will only damage the tissue further.

Table 1
COLD ILLNESSES

Cold Illness	Symptoms	Possible Underlying Causes	Treatment
Hypothermia	• Pain in the extremities • Uncomfortable shivering and the sensation of cold • Reduction of body core temperature • Cool skin • Rigid muscles • Slowing of heart rate • Weakening of pulse • Low blood pressure • Irritability of heart muscle • Sometimes heart beating abnormally in respect to strength and rhythm • Slow irregular breathing • Memory lapses • Vague slow slurred speech • Drowsiness • Incoherence	• Exposure to low air temperatures, high wind, inadequate clothing or water immersion • Underlying disease, such as heart or blood vessel disease • Old age • Allergies • Alcoholism • Recent alcohol consumption • Smoking • Medications that affect the temperature-regulation mechanism • Exhaustion • Sedative drugs • Dehydration	• Get the victim out of the wind, snow, or rain • Keep use of energy to a minimum • Keep person awake • Victim should be handled on a stretcher if movement is necessary • Strip off all wet clothes • Get person into dry clothes • Wrap blanket around victim • In conscious victims, body should be packed with heat packs or wet towels no warmer than 105˚F, behind the neck, groin, and armpits • Do not rewarm

	• Diminished reaction time • Diminished coordination • Diminished dexterity		extremities and the core at the same time • Provide lifesaving actions as necessary - mouth-to-mouth resuscitation or cardiopulmonary resuscitation (CPR), if trained • If blankets, sleeping bag, newspapers, heat packs, or wet towels are not available, rewarm victim with body heat • Give sweet warm drinks to conscious victims • Do not immerse victim in a warm water bath • Take victim to the hospital by calling an ambulance and telling them that a cold illness emergency exists
Raynaud's Syndrome	• Fingers turn white and stiff • Intermittent blanching and reddening of the fingers and toes • Affected area tingles and becomes very red or reddish purple	• Exposure to low air temperature, high winds • Inadequate clothing • Underlying disease such as blood vessel disease	• Remove to warmer area • Consult physician
Acrocyanosis	• Hands and feet are cold, blue, and sweaty	• Exposure to cold • Inadequate clothing • Underlying disease such as blood vessel	• Remove to warmer area • Loosen tight clothing • Consult

		disease	physician
Frostnip	• Skin turns white	• Exposure to cold	• Remove to warmer area • Refer to treatment for frostbite
Chilblain	• Recurrent localized itching, swelling, and painful inflammation of the fingers, toes, or ears • Severe spasms	• Inadequate clothing • Exposure to cold and moisture • Underlying disease such as blood vessel disease	• Remove to warmer area • Consult physician
Trench Foot	• Edema • Tingling, itching • Severe pain • Blistering	• Exposure to cold and dampness	• Remove to warmer area • Consult physician • Refer to frostbite treatment
Frostbite	• Skin changes color to white or grayish yellow, progresses to reddish violet, and ultimately turns black • Burns at first • Blisters • Affected part cold, numb, and tingling	• Exposure to cold • Lack of acclimatization • Age (very young or old) • Physically disabled or mentally impaired • Underlying diseases, such as heart and blood vessel disease	• Cover the frozen part • Provide extra clothing and blankets • Bring victim indoors as soon as possible • Place the frozen part in warm water at a temperature of 102°F to 105°F or rewarm with warm packs • If affected part has been thawed and refrozen, do not use water, rewarm at room temperature • If no water is available, wrap gently in a sheet and blanket • Discontinue

			warming the victim as soon as the affected part becomes flushed and swelling develops after thawing • Exercise part after rewarming, but do not allow victim to walk after the affected part thaws • Place dry sterile gauze between affected fingers and toes, do not apply other dressings unless victim is to be transported for medical aid • If travel is necessary, warm affected parts with sterile or clean cloths during transportation • Elevate the frostbitten parts and protect them from contact with bedclothes • Give sweet, warm fluid if victim is conscious and not vomiting; no alcoholic or caffeine beverages • In absence of warm water, frostbitten fingers should be placed uncovered under the armpits next to skin • If the toes or

			heels are affected, footwear should be covered with dry socks • If above measures for feet are not possible, place bare frostbitten feet against the belly of a companion or under clothing • If the cheeks are frostbitten, cover the affected areas with warm hands until the pain returns • Following rewarming, wounds should be treated in open and sterile manner; bandages hamper the circulation • Deep frostbite should not be thawed in the field • Do not rub the part with anything (including snow and ice), apply heat lamp or hot water bottles, place injured part near a hot stove, or break blisters • Obtain medical assistance as soon as possible

4.8 Preventing Cold Stress

In preventing cold stress, factors relating both to the individual and the environment must be taken into account. For the individual, that means acclimatization, adherence to work practices, water and salt replacement, medical screening, continuing medical supervision, proper work clothing, training, and

education. Controlling the environment involves engineering controls, work practices, work-rest schedules, environmental monitoring, and monitoring the wind chill temperature.

4.8.1 Cold Stress Work Practices

- Older workers, or workers with circulatory problems, need to be extra careful in the cold. Additional insulating clothing and reduced exposure time should be considered for these workers.
- Obese and chronically ill people need to make a special effort to follow preventive measures.
- Sufficient sleep and good nutrition are important for maintaining a high level of tolerance to cold.
- If possible, the most stressful tasks should be done during the warmer parts of the day. Double shifts and overtime should be avoided. Rest periods should be extended to cope with increases in cold stress.
- A worker should go immediately to a warm shelter if any of the following symptoms are spotted: the onset of heavy shivering, frostnip, the feeling of excessive fatigue, drowsiness, irritability, and euphoria.
- The outer layer of clothing should be removed when entering a heated shelter. If possible, a change of dry work clothing should be provided to prevent people from returning to work with wet clothing. If this is not feasible, the remaining clothing should be loosened to permit sweat to evaporate.
- Alcohol should not be consumed while in the warmer environment.
- Anyone on medications such as blood pressure control or water pills should consult a physician about possible side effects from cold stress.
- It is strongly recommended that workers suffering from diseases or taking medication that interferes with normal body temperature regulation, or that reduces tolerance of cold, not be permitted to work in temperatures of 30°F or below.
- It is a good idea for people to weigh themselves at the beginning and end of the workday to check for weight loss that might occur from progressive dehydration.

4.8.2 Acclimatization

Some degree of acclimatization may be reached in cold environments, but it is usually not significant.

With sufficient persistent exposure to cold, the body undergoes some changes that increase comfort and reduce the risk of cold injury slightly. However, these physiological changes are usually small and require repeated, uncomfortably cold exposures to induce them.

Some people do not acclimatize readily, such as those who are physically unfit, older, obese, taking medications, or using alcohol or drugs.

4.8.3 Fluid Replacement

Working in cold areas causes high water losses through the skin and lungs due to the dryness of the air. Increased fluid intake is essential to prevent dehydration, which affects the flow of blood to the extremities and increases the risk of cold injury.

Warm, sweet, caffeine-free, nonalcoholic drinks and soup should be available at the work site for fluid replacement and caloric energy.

4.8.4 Salt Requirements

The body needs a certain amount of salt and other electrolytes to function properly. However, using salt tablets is not recommended. Salt tablets cause stomach irritation, which may include nausea and vomiting. A normal, balanced diet should take care of salt needs. In the event that salt intake needs to be increased, utilize electrolyte replacement fluids like Gatorade™. Anyone with high blood pressure or on a restricted sodium diet should consult a physician for advice regarding salt intake.

4.8.5 Diet

It is important for people who work in cold environments to eat a well-balanced diet. Restricted diets can deprive the body of elements needed to withstand cold stress.

4.8.6 Control Measures

Continuous exposure of skin should not be permitted when the wind chill factor results in an equivalent temperature of -25°F.

Workers exposed to air temperatures of 35.6°F or lower who become immersed in water or whose clothing gets wet should be given dry clothing immediately and treated for hypothermia.

Cold stress can be controlled by engineering, administrative work practices, and use of personal protective equipment (PPE).

Engineering Controls

Here are some of the ways engineering controls can be used to reduce the stress of a cold environment:

- General or spot space heating should be used to increase temperature at the workplace.
- If fine work is to be performed with bare hands for more than 10 or 20 minutes, special provisions should be made to keep the worker's hands warm. Warm air jets, chemical hot packs, radiant heaters, or contact warm plates can be used.
- At temperatures below 30°F, metal handles of tools and control bars should be covered with thermal insulating material.
- Unprotected metal chair seats should not be used.
- When necessary, equipment and processes should be substituted, isolated, relocated, or redesigned to reduce cold stress at the work site.
- Power tools, hoists, cranes, or lifting aids should be used to reduce the work load.
- Heated warming shelters such as tents and cabins should be made available if work is performed continuously in an equivalent chill temperature of 20°F or below. Workers should be encouraged to use the shelters regularly.

Engineering control of cold stress can be very complex and often depends more on ingenuity than on standard methods.

Administrative Work Practice Controls

These controls include any work practices or rules designed to reduce the total cold-stress burden. Some of them are:

- work-rest schedule (see Attachment 2) to reduce the peak of cold stress
- enforcing scheduled rest breaks
- enforcing the buddy system (pairing up)
- enforcing frequent intake of warm, sweet, caffeine-free, nonalcoholic drinks or soup
- moving work to warmer areas whenever possible
- assigning extra workers to highly demanding tasks
- allowing workers to pace themselves and take extra work breaks when needed
- making relief workers available for workers who need a break
- teaching workers the basic principles of preventing cold stress and emergency response to cold stress
- maintaining protective supervision or a buddy system for those who work at 10°F or below
- allowing new employees time to adjust to conditions before they work full-time in cold environments
- arranging work to minimize sitting still or standing for long periods of time
- reorganizing work procedures so as much of a job as possible is done in a warm environment, which will reduce the amount of work that must be done in a cold environment
- including the weight and bulkiness of clothing when estimating work performance requirements and weights to be lifted

Personal Protective Equipment and Clothing

PPE takes in a wide range of garments and equipment, from ordinary work clothing to special bodysuits. The correct clothing depends on the specific cold stress situation.

Workers should wear several layers of clothing instead of a single, heavy, outer garment. In addition to offering better insulation, the layers can be removed as needed to keep the worker from overheating.

The outer layer should be windproof and waterproof. Body heat is lost quickly if the protective layer is not windproof.

Attachment 3 lists recommended fabrics for the various layers of clothing.

It is essential to preserve the air space between the body and the outer layer of clothing to retain body heat. The more air pockets each layer of clothing has, the better the insulation. However, the insulation effect is negated if the clothing interferes with the evaporation of sweat, or the skin or clothing is wet.

The most important parts of the body to protect are the feet, hands, head, and face. Hands and feet are the farthest from the heart and become cooled most easily. Keeping the head covered with a hat or hood is important, because as much as 40 percent of body heat can be lost when the head is exposed. Gloves and adequately insulated foot protection are essential to maintain and conserve body heat.

Dirty or greasy clothing loses much of its insulation value. Air pockets in dirty clothes are crushed or filled up, and heat can escape more easily.

Any interference with the circulation of the blood reduces the amount of heat delivered to the extremities. All clothing and equipment must be properly fitted and worn to avoid interfering with the circulation.

Remember to think C-O-L-D to keep warm in a cold environment: keep clothing clean, avoid overheating, wear clothing loose and in layers, and keep clothing dry.

Recommended clothing includes:

Light Activity

Inner Clothing

A cotton t-shirt and shorts or underpants under cotton and wool thermal underwear for light activity. Two-piece long underwear is preferred, because the top can be removed and put back on as needed.

Socks with high wool content are best. When two pairs of socks are worn, the inside pair should be smaller and made of cotton. In a pinch, wool socks can also double as mittens.

Outer Clothing

Wool or thermal trousers (either quilted or specially lined) are preferred. Belts can constrict and reduce circulation, so use suspenders if necessary. You will need extra room for trousers to fit over long underwear. Trousers should be lapped over boot tops to keep out snow or water. A synthetic, windproof, and preferably waterproof, shell layer can provide the final layer of protection.

Heavy Activity

Foot Protection

For heavy work, a felt-lined, rubber-bottomed, leather-topped boot with a removable felt insole works well. The boots should be waterproofed and socks changed when they become sweat-soaked. Air insole cushions and felt liners should be used with chemical and/or water-resistant boots. The best foot protection is provided by insulated boots sealed inside and outside by vapor barriers.

Protective Garments

Either a wool shirt, wool sweater, or a down jacket over a synthetic shirt (such as polypropylene or capilene) should be worn. Size-graduated shirts and sweaters can be worn in layers. Wool pants are a better choice than jeans or corduroy. Synthetic materials used in jackets or pants, such as Thinsulate, Qualofil, and pile, are ideal.

An anorak or snorkel coat or arctic parka should fit loosely, with a drawstring at the waist. Sleeves should fit snugly. The hood, which prevents the escape of warm air from around the neck, should be capable of extending past the face to create a frost tunnel, which warms the air for breathing.

Finish with a windproof, and preferably waterproof, shell layer. Check the shell for wind seals at the waist, neck, wrists, and ankles.

Head, Eye, Face, and Respiratory Protection

A wool knit or synthetic cap provides the best protection. When a hard hat is worn, a liner should be used.

Wool or synthetic mittens are more efficient insulators than gloves; they can be worn over gloves for extra warmth.

A face mask or scarf is vital when working in a cold wind. A ski mask with eye openings gives better visibility than a snorkel hood. Face protectors must be removed periodically, so the worker can be checked for signs of frostbite.

Thermal-type masks and respirators are available for those bothered by breathing very cold air. Full-face respirators must have separate respirator channels to prevent fogging and frosting of the facepiece. Medical clearance is required prior to issuing any respiratory protective equipment.

Double-layered goggles with foam padding around the edges have proved to be effective in extremely cold conditions.

Hand Protection

Liquids conduct heat better than air and have a greater capacity for heat than air. For example, a spill of cold gasoline on skin can freeze the tissue quickly. It is a good idea to wear chemical-resistant gloves—such as neoprene gloves with cotton inserts—for chemical handling operations. If you are handling chemicals with permeable-type gloves, always keep extra gloves available in case the ones you are using become contaminated.

Gloves should be used by workers if manual dexterity is not required, or if the air temperature falls below 60°F for sedentary work, 40°F for light work, and 20°F for moderate work. Mittens should be used instead of gloves if the air temperature is 0°F or less.

Emergency Actions

When stranded during a storm in a vehicle, it is better to stay with the vehicle. The engine can furnish heat, and the vehicle can act as a shelter. However, care should be taken to prevent carbon monoxide gas from building up in a closed vehicle. In an emergency situation, insulating material can be taken from the vehicle seats and stuffed into clothing for additional warmth.

If you are in the water, try to reach something that will keep you afloat, but do not do any unnecessary swimming—it increases the rate of body heat loss. Air between layers of clothing provides buoyancy. Personal flotation devices (PFDs) offer your best chance of survival in cold water. Type III PFDs include cold weather jackets and coats that contain flotation material and thermal protection.

It is especially important to keep your head dry. Avoid thrashing about if wearing a PFD, and assume the H.E.L.P. position (Heat Escape Lessening Posture), Attachment 4, by crossing your wrists over your chest and keeping your legs close together to avoid using excess body heat. By using the H.E.L.P position, you can protect your head, neck and groin area—all of which are high heat loss areas.

If others are in the water with you, huddle together. This will reduce heat loss, aid in rescue, and may even boost morale.

Keep in mind that survival floating techniques may not work in extremely cold water.

4.9 Control Program Summary for Cold Stress

A control program summary for cold stress at AEE includes the following elements:

- medical supervision of workers, including preplacement physicals that evaluate fitness, weight, and cardiovascular system, and other conditions that might make a worker susceptible to cold stress
- required medical evaluation during and after cold illnesses and required medical release for returning to work
- employee orientation and training on cold stress, cold-induced illnesses and their symptoms, water and salt replacement, proper clothing, work practices and emergency first aid procedures

- work-rest regimens, with heated rest areas and enforced rest breaks
- scheduled drink breaks for recommended fluids
- environmental monitoring, using the air temperature and wind speed indices to determine wind chill and adjust work-rest schedules accordingly
- reduction of cold stress through engineering and administrative controls, and the use of PPE

5.0 REFERENCES

1. National Safety Council. 1986. *Pocket Guide to Cold Stress*.
2. American Conference of Governmental Industrial Hygienists (ACGIH). 2001 Threshold Limit Values (TLVs™) for Chemical Substances and Physical Agents and Biological Exposure Indices (BEIs™).
3. American Red Cross. 1993. Standard First Aid. St. Louis: Mosby Lifeline.

Drilling Safety

1.0 PURPOSE

The purpose of this standard operating procedure (SOP) is to provide AMEC Earth & Environmental, Inc. (AEE) personnel with procedures for general drilling safety, including aspects at sites that have been characterized as hazardous or potentially hazardous.

2.0 SCOPE

This procedure applies to members of AEE field teams, including subcontractors, involved in drilling and associated activities.

3.0 RESPONSIBILITIES

3.1 Corporate Safety, Health, and Environment Director

The Corporate Safety, Health, and Environment Director (Corporate SHE Director) is responsible for preparation of this procedure. The Corporate SHE Director will ensure that the SOP is incorporated into projects where drilling is occurring. The Corproate SHE Director will assist the Field Manager (FM) and/or Site Health and Safety Coordinator (SHSC) with implementation where necessary.

3.2 Site Health and Safety Coordinator

The SHSC serves as the primary coordinator for activities associated with drilling operations at field sites. The SHSC shall receive the inspection reports for drilling equipment used on-site from the subcontractor.

3.3 Field Manager

The FM or designee who works in or around drilling operations is responsible and accountable for adhering to and enforcing this procedure.

The FM is responsible for:

- ensuring that all employees assigned to drilling activities are instructed in the types of hazards associated with drilling operations
- ensuring adherence to safe work practices and techniques
- directing a prework safety meeting
- ensuring that personnel leave the drilling site if a potentially hazardous condition is recognized

3.4 Field Personnel

All field personnel involved in drilling at all locations shall be familiar with this procedure and work within the guidelines provided.

3.5 Subcontractors

All subcontractors involved in drilling shall be familiar with this procedure and work within the guidelines provided. The subcontractor supervisor (or designee) is also responsible for performing and documenting equipment safety inspections.

4.0 PROCEDURE

The following guidelines shall be implemented during general drilling operations.

4.1 Hazards Encountered Prior to or during Drilling

4.1.1 Fire and Explosion

To lower the potential for fires or explosions at drill sites:

- Flammable liquids shall not be stored or left within 50 feet of drill rigs, pumps, grout plants, or other related machinery (includes empty/full cans).
- Excess flammables will be stored in Underwriter's Laboratory (UL)-approved safety cans or Department of Transportation (DOT)-approved drums with the appropriate dispensing device in a secure area on-site.
- Smoking, open flames, or spark-producing equipment, including lighters, matches, etc., are not permitted within 50 feet of drill rigs, open wells, gasoline-driven pumps, or fuel storage areas. Open flames greater than 25 feet from such areas are only permitted with the issuance of a Hot Work Permit in accordance with SOP S-8, *Hot Work Permits*.
- An appropriately sized ABC fire extinguisher shall be located within the Exclusion Zone, not less than 10 feet but not greater than 25 feet from any operating drill rig. Fire extinguishers should be periodically inspected by the SHSC and maintained in operating condition at all times. Records shall be kept showing the date when the equipment was last inspected, tested, or refilled.
- When refueling equipment, a fire extinguisher shall be located no less than 10 feet from the equipment. Equipment engines shall be shut off during fueling.
- Grounded fuel containers will be used. If using dispensing fuel containers, all containers must be UL-approved and equipped with flame arrestors. These fuel cans shall be returned to a designated safe storage area after fueling is completed.
- Drums containing Class 1 liquids (e.g., gasoline) must be stored in a vertical position and must be equipped with a dispensing pump. These liquids (e.g., gasoline) shall <u>not</u> be dispensed by gravity from tanks or drums. Metal drums and pumps shall be electrically grounded and a bond installed to metal containers being filled with Class 1 liquids. UL-approved, self-closing flammable cans must be used for the storage of Class 1 liquids that are in immediate use. When not in use, flammable cans should be stored in a safe storage area.
- Class 2 liquids (e.g., diesel fuel) may be stored in a vertical or horizontal position, and may be dispensed by gravity from tanks and drums, provided they are equipped with a UL-listed, self-closing valve. Class 2 liquids must also be contained within a UL-approved flammable can and, when not in use, stored in a safe storage area. These liquids may be dispensed by gravity from tanks and drums provided they are equipped with self-closing valves.

- Class 3 liquids may not be dispensed by gravity from tanks and drums inside a building without local fire department approval. All combustible liquid storage must be in compliance with local code and ordinance requirements.
- The mouths of all metallic containers of 5 gallons or less must be kept in metallic contact during the transfer of flammable liquids.
- Extreme caution shall be used during drilling in areas where explosive gases/vapors are suspected. If 10% (or higher) lower explosive limit (LEL) explosive gases are detected in the hole being drilled (see Section 4.3.7, Air Monitoring) cease operations and contact the Corporate SHE Director. Be sure all ignition sources are extinguished.
- All ignition sources, such as drill rig engines, compressors, and generators, shall be placed upwind or crosswind of drill holes that could potentially contain explosive gases greater than 10% LEL.
- If fire extinguishers are used to fight a fire, the extinguisher shall be temporarily replaced and refilled or permanently replaced immediately after use.

4.1.2 Hazardous Noise

Measurements indicate that during drilling operations, the allowable noise level of 85 dBA is routinely exceeded. In consideration of this:

- All workers shall wear hearing protection whenever they are working in high noise areas in the vicinity of drilling equipment.
- Hearing protection shall be worn if measurements have not been made, or if workers have to shout to communicate when they are 3 feet apart or less.
- Hearing protection shall be worn by all personnel within 25 feet of split-spoon driving and removal when grout/cement mixing equipment is in operation, when direct push probes are being advanced, and at any other locations where there is the potential to be exposed to hazardous noise.

Refer to SOP H-10, *Hearing Conservation Program*, for additional information.

4.1.3 Ergonomics

Mobilization and demobilization require drilling equipment, air monitoring equipment, sampling equipment, and related items to be moved. Personnel should always test an object to obtain a rough estimate of its weight prior to actually lifting. If the object will cause the worker to strain upon lifting, then two or more workers (as many as necessary) shall lift the object. Lifting should always be performed in such a way that the lifter brings the load as close to the body as possible. When necessary, site workers shall make two trips to carry several objects, rather than straining to carry many objects in one trip.

Waste drums can be extremely heavy and difficult to move. It is typically necessary to transfer the drums from the location where sampling took place to the drum storage area. When transferring drums, personnel shall use a drum dolly, forklift (with a trained operator), or other appropriate means. Personnel shall not roll waste drums from one location to another, nor shall drums be dragged as a means of moving them.

Several parts of the sampling equipment decontamination procedure pose ergonomic hazards. Decontamination of sample equipment involves vigorous manual scrubbing with brushes, stooping over and reaching into decontamination buckets, repeated use of spray bottles, and lifting of buckets to

transfer the contents to remotely located waste drums. Site workers can easily develop wrist, hand, finger, arm, neck, and back pain from repetitively or carelessly performing the above procedures or from working in an inappropriate work posture. Decontamination buckets shall be elevated to prevent back strain. Hand and finger pain can be prevented with the use of hand-powered pumped spray devices rather than triggered spray bottles. Equipment decontamination areas can also be arranged to reduce ergonomic stress. Drums can be transported by a drum dolly to the location of the decon buckets, or lids can be placed on the buckets and the buckets moved by an appropriate method (not in clean vehicles). Rotation of personnel on job tasks will help prevent the potentially hazardous effects of decontamination tasks.

To lower the potential for injuries during material handling:

- Extreme caution shall be used when lifting or moving heavy materials.
- All personnel shall have a thorough knowledge of proper lifting techniques, which must be employed when necessary.
- Two or more persons shall lift or move materials weighing 50 pounds or more. Such materials would include 10-inch or larger augers, pumps, full 55-gallon drums, and bulky objects. Mechanical means such as forklifts and lift gates on trucks shall be used whenever practical.

4.1.4 Rotating Machinery

Before performing work on rotating machinery or on automatic equipment, the position of all electrical control or starting devices must be verified. When inspections or repairs are to be made, all remote-controlled or automatic start parts must be controlled by locking out the circuit breakers or switches and pulling the fuses. Refer to SOP S-2, *Control of Hazardous Energy Sources (Lockout/Tagout)*.

Machinery that is connected to blowers, water wheels, or pumps without check valves may turn even when the current to the motor has been disconnected. The rotor or armature must be blocked to achieve a state of zero energy.

When rotating or automatic machinery is in operation, workers will not remove or adjust motor brushes, contacts, commentators, or slip or collector rings.

To avoid entanglement during operation, employees will not wear loose clothing or loose gloves, wrist watches, rings, or metal pendants around rotating or automatic equipment. Long hair must be tied back or put up under the hard hat.

No one will reach into rotating equipment while in operation. Reaching in is not safe until the rotating equipment is fully shut off and only then with an adequately long tool like a long-handled shovel.

4.1.5 Heat Stress

Detailed information regarding heat stress hazards is provided in SOP H-9, *Heat Stress Control*.

4.2 Specific Operations

4.2.1 Clearing the Work Area

Prior to drill rig setup, adequate site clearing and leveling should be performed to accommodate the drill rig and supplies and provide a safe working area. Drilling shall not commence when tree limbs, unstable ground, or site obstructions cause unsafe equipment handling conditions.

The following items serve as a guide to drilling operations safety measures but should not be considered inclusive:

- Clear work area of obstructions and debris prior to rig setup.
- Level and stabilize the rig prior to raising the mast.
- Grade the site if the working platform is unstable.

Underground and overhead utilities must be identified by:

- • local "dig-alert" location service
- • mechanical and visual inspection of the site
- • review of available site plans for the area
- • information supplied by utility company personnel

Precautions and preplanning will be used to avoid intrusion or impact during site activities. Where necessary, utilities will be deactivated prior to site activity. If subsurface work is being performed in areas with fill material, digging will be initiated manually, using a shovel, to avoid contacting utility lines. To avoid contacting underground utilities, a minimum distance of 5 feet will be maintained between all equipment and detected underground lines. To avoid contacting or arcing with overhead utility lines, a safe distance of at least 20 feet will be maintained between all equipment and overhead lines, in accordance with AEE policy.

Alternatives to safe distances include deenergizing the overhead utility line and visibly grounding it at the point of work, or placing insulating barriers that are not a part of or attached to the equipment over the live lines to prevent physical contact with the line. Workers are prohibited from moving drill rigs with masts deviating from the horizontal position. Masts must always be lowered before moving drill rigs. Safe Work Practices, Section 6.8, and Universal Hazards and Controls, Section 5, of Volume II, Comprehensive Field Project Health and Safety Program, of this manual, and SOP S-2, *Control of Hazardous Energy Sources/(Lockout/Tagout)*, of this volume, provide additional information about electrical safety.

4.2.2 Start-Up

Hollow-stem auger rig components are shown in Attachment 1. Direct rotary rig components are shown in Attachment 2. Direct push ring components are shown in Attachment 3.

After the subcontractor supervisor completes the drill rig inspection and documentation (Attachment 4, Daily Drill Rig Checklist), the following shall apply:

- Ensure that all gear boxes, hoist levels, and hydraulic levers are in the neutral position.
- Ensure that the cathead rope or catline is not on the cathead before starting the engine.
- All site personnel should be instructed to "stand clear" of the drill rig immediately prior to and during start-up of an engine.
- The subcontractor shall place a sheet of polyethylene completely under the rear end of the drill rig to catch any contamination resulting from drilling activities and protect the surrounding area. The plastic shall be used only once per borehole and shall be placed into 55-gallon, DOT-approved drums for disposal after use.
- Drill rig platforms and stairs along with the immediate work area must be kept clear; do not allow oil, grease, and/or excessive mud shall not be allowed to accumulate in these areas.

- The discharge of drill rig fluids and foam must be channeled away from the work area to prevent ponding or slippery conditions. In addition, drilling fluids and foam residues must be properly disposed of in 55-gallon, DOT-approved drums.

4.2.3 Direct Push Probing (e.g., Geo-Probeâ , Stratoprobeâ)

Direct push probing is accomplished by using a specifically designed hydraulically powered, percussion/probing machine. The direct push equipment is typically mounted in a truck, van, or a specialized cart. This probing technique can be used to collect soil samples, groundwater samples, and soil gas samples.

The following is an overview of the hazards and control measures for direct push drilling technology. The drilling operator is expected to have superior knowledge of safe operation of the rig and associated equipment.

- Noise is one of the more noticeable hazards associated with advancing the probe with the hammer armature. Hearing protection must be worn by personnel in the vicinity of the direct push rig.
- The location and proper operation of the emergency stop (kill switch) will be indicated to the SHSC and the drilling crew.
- Any working platform area will be level and free of debris.
- Probe cuttings not packaged as samples will be deposited into a properly labeled, DOT-approved 55-gallon drum.

4.2.4 Safe Operation of Drill Rigs and General Site Conditions

The following is an overview of safe drill rig work practices for reference only. The drill rig operator is expected to have superior knowledge of the safe operation of the rig and its appurtenances.

- The driller-in-charge shall assure that only qualified drillers operate the rig.
- The drill and augers shall be handled and operated in a safe manner.
- If cable repairs on the mast are required, the mast shall be lowered.
- For cases where the mast cannot be lowered: Unless ascending or descending a mast or derrick by means of a ladder fitted with approved OSHA cage guards, no person should attempt to ascend or descend unless wearing an approved full-body harness with shock absorbing capabilities. The harness shall be correctly fitted, adjusted, and attached to a mobile safety climbing device (rope or cable). Workers shall be instructed in the correct procedures by a skilled person. Refer to SOP S-7, *Fall Protection and Prevention*, for procedural information.
- A full-body harness and lifeline shall be provided and its use required for each employee who works 6 feet or more above the floor or main work deck.
- Only personnel who are qualified and trained in drilling (i.e., drillers and their helpers) shall handle equipment associated with drilling operations. Included are augers, drive rods, ropes, cables, etc.
- Maintain proper clearance (at least 20 feet) from overhead hazards such as power lines.
- Under no circumstances shall the drill rig be moved with the mast raised, no matter how small the distance.

- On-site hazards shall be kept to a minimum. Items such as hand tools, rakes, shovels, etc. shall not be left lying on the ground (tripping hazards).
- All brush over 4 feet high in the vicinity of the drilling operations shall be cut.
- Site entry/exit pathways, as well as work areas in the Exclusion Zone and decontamination area, shall be defined and kept clear of all items and debris.
- Properly secured items such as pallets may be used as platforms or walkways to provide better footing in wet and muddy work areas.
- During site activities, the minimum drilling crew to be employed will consist of one trained, experienced driller and one helper.
- The drilling crew and SHSC will be aware of the location and proper operation of the rig's emergency shutdown equipment (kill-switches, etc.) and procedures.
- Watch for slippery ground when mounting/dismounting the drill platform.
- All persons in the vicinity of the drill rig must wear safety glasses with side shields at all times.
- The brakes shall be set and/or wheels blocked when the rig is set up at a site.
- A drill rig should only be operated from the position of the controls.
- Clean mud and grease from boots before mounting a drill platform.
- Never leave the drill rig unattended while it is operating.
- AEE personnel (geologists, engineers, etc.) will not assist the drill crew with their work while the drill rig is operating.
- Subcontractors shall ensure, however, that AEE personnel know how to turn off drilling equipment in case of an emergency.
- Extreme care will be used during placement or removal of augers and casings and during start-up of rotating drilling equipment (such as hollow-stem augers, rotary tables, and catheads).
- Dust suppression techniques will be employed to the greatest extent possible to minimize the generation of dust/particulates and associated contaminants into the atmosphere. A water tap should be fitted with a nozzle or other device to create a water spray or curtain to contain dusts.
- No petroleum-based grease or oil shall be used on auger pipe joints; however, Teflon grease or vegetable oil is acceptable.
- Drill rods or core barrels should never be left unsecured, balanced across, or leaning on the rig.
- Operators should keep all body parts and loose clothing away from rotating augers.
- When moving a rig off-road, be aware of any obstacles in the route of travel. It is recommended to walk the route first. Walk around the rig before demobilization to check for obstacles.
- Have an assistant guide the driver when in proximity to hazards or if clearance is at a minimum.
- Do not move drill rigs up or down steep slopes without the assistance of a dozer tagging it off.
- Heavy equipment cannot stop quickly on wet ground; therefore, allowances should be made to ensure a safe stopping distance.
- All unattended boreholes must be adequately covered.

4.2.5 Derricks/Masts

A derrick or mast is the tower component of a drilling or well-servicing rig that supports the crown block assembly (over which hoisting lines are reeled), the traveling block (travels between the derrick or mast floor and crown block), and hoisting lines. The term "monkey board" is often used to describe the derrickman's working platform.

Procedures for working on or near derricks/masts are as follows:

- Before raising the mast, look for overhead obstructions.
- Before raising the mast, make sure the drill rig is level and stabilized.
- Lock the mast in place before drilling.
- All loose tools and materials shall be removed or secured, and no worker shall be allowed under the derrick while it is being lowered or raised.
- All derricks and portable masts should be equipped with approved fixed ladders to provide access to all working areas from the floor to the crown. Drill rig masts shall not be used as ladders.
- Rig personnel shall always face the ladder when ascending or descending.
- For cases where the mast cannot be lowered: Unless ascending or descending a mast or derrick by means of a ladder fitted with approved Occupational Safety and Health Administration (OSHA) cage guards, no person should attempt to ascend or descend unless wearing an approved full-body harness with shock absorbing capabilities. The harness shall be correctly fitted, adjusted, and attached to a mobile safety climbing device (rope or cable). Workers shall be instructed in the correct procedures by a skilled person. Refer to SOP S-7, *Fall Protection and Prevention*, for additional information.

4.2.6 Hollow Stem Auger Drilling

Hollow stem auger drilling is particularly useful in obtaining accurate samples. Penetration rates are relatively slow compared to those of rotary drilling (discussed in Section 4.2.6). An example of the typical drill rig used for hollow stem auger drilling is provided in Attachment 1. Precautions for hollow stem auger drilling include:

- Handle augers with care. Serious injury or death can result from being caught or pinched in rotating equipment or from improper lifting of augers.
- Be aware of the rig's emergency shut-down equipment (kill-switch) and procedures
- Use proper lifting techniques; use a tool hoist, if possible.
- Stay clear of rotating augers and pinch points, such as cables and pulleys.
- Passage under, or stopping over, a moving stem or auger is prohibited.
- Drill crews are not allowed on the mast while the drill bit/auger is in operation or during transport.
- Long-handle shovels will be used to remove cuttings from around the auger. Never reach in around the augers while operating.
- Loose clothing, hair, or jewelry are not permitted near rotating augers.
- Placing hands or shovels on augers while they are rotating is forbidden; burrs and or damaged augers can grab and pull tools or people into the rotating augers.

4.2.7 Rotary Drilling

Rotary drill rigs operate with either an air-based or water-based drilling fluid. The borehole is drilled by rotating a bit. In the air rotary method, air alone lifts the cuttings from the borehole. A large compressor provides air that is piped to the swivel hose. The air, forced down the drill pipe, escapes through small ports at the bottom of the drill bit. The cuttings are blown out the top of the hole and collect at the surface around the borehole. Injecting a small volume of water or surfactant and water (foam) into the air system controls dust and lowers the temperature of the air. Cuttings are removed by continuous circulation of the fluid. For safety reasons, a dust deflector shall be used during open-hole air or mud settings. A divertor and cyclone shall be used for casing advancement or reverse circulation situations. A diagram of a direct rotary drill rig is provided in Attachment 2.

- The ends of connecting hose sections shall be secured together by means of clamps and a safety chain or wire rope. The clamps shall be tightly fitted to and near the ends of the connecting hose sections and the chain or wire rope securely fastened to each of the clamps.
- The site staff shall be instructed to not stand close to the hoses and cyclone discharge. Sometimes large rocks are discharged and can cause the hosing to significantly deflect and move. Someone standing nearby can be knocked off balance.
- The standpipe of the rotary drilling rig is a vertical pipe that joins the rotary hose to the circulation system. The standpipe end of the circulating hose shall be secured to the standpipe, derrick, or mast, and the other end to the circulating pump by a clamp and chain and wire rope. Clamps shall be tightly fitted to and near the end of the hose and the chain or wire rope attached to it; to the standpipe, derrick, or mast; and to the mud pump skid.

4.2.8 Split-spoon Sampling

Split-spoon soil sampling requires that an impact hammer connected to a wire pull rope, which is wound around a "cathead" pulley, be used to drive the split-spoon sampler into the hole to collect soil samples at various depths. The pull rope is manually pulled and released to lift and drop the hammer, driving the sampler into the soil. The following precautions shall be adhered to during split-spoon sampling:

- • Workers who operate the driving hammer shall be thoroughly trained in the proper use of the impact hammer. Only drillers who are thoroughly trained and experienced shall operate the pull rope to drive down and pull up the sampling device.
- • No one shall bend down or stand directly below the hammer while sample driving or removing is in progress.
- • If the sample rod must be kept straight and steady, a mechanical holding device with quick-release capability shall be attached to the drilling rig to support the sampling rod and guide the hammer.
- • Before each use, the wire pull rope shall be inspected for wear; the cable securing the rope to the hammer will be checked to verify that it is securely fastened (see Wire Rope Wear and Damage illustrations, Attachment 5).
- • Wire pull ropes shall be replaced if the inspection reveals signs of severe wear such as fraying, etc. Refer to Section 4.3.5 for inspection information.
- • Before each use, the driller, along with his helper, shall inspect the sample rods for cracks and other signs of severe wear.
- • Rods shall be replaced and shall not be used if they are found to be cracked or otherwise damaged.

- • The hammer shall be inspected before each use. Particular attention shall be given to welded areas (i.e., the handle used to attach the pull rope).
- • Hearing protection is mandatory while driving split spoons.

4.2.9 Catheads, Rope Hoists, and Saf-T-Drivers

A cathead is a spool-shaped metal, mechanical device mounted on the end of a shaft on which the rope is wrapped. The rotating cathead imparts a pulling power to the rope that is wrapped on it. Catheads are extremely dangerous. Damaged catheads should be replaced so worker safety is not further jeopardized. For safety reasons, a Saf-T-Driver hoist is typically used to replace a cathead.

- If a cathead is mounted on the end of a shaft that projects beyond the guard for other moving parts of machinery, the shaft end, key, or other device for securing the cathead to the shaft, should be covered with a smooth thimble. The thimble should be of such a design that a rope cannot wind around it.
- Catheads on which the catline is manually wound shall have a reasonably smooth surface, be equipped with a divider for separating the first wrap of the catline from subsequent wraps, and be free of projections on which an employee's clothing might be caught during operation of the catline.
- In the event of fouling, no attempt should be made to free the line while a cathead is in motion.
- While operating the cathead, the operator will be on a slip-free surface.
- The catline must be the right length, clean, preferably dry, and sound.
- Not more than one wrap should be put on a cathead until all slack has been taken up and initial tension has been applied.
- While the rope is wrapped on the drum, the cathead must always be attended.
- The catline must never be wrapped around any part of a worker's body.
- Use an adequate amount of wraps on the cathead to hoist the load.
- The cathead barrel must be kept free of rust, grease, and rope grooves.
- Loose clothing or loose gloves may not be worn while operating the cathead.
- An adequate amount of clearance must be maintained between other hoist lines to prevent contact with the catline.
- An adequate amount of clearance must be maintained between personnel and the impact hammer.
- Personnel must keep at least 18 inches away from the cathead drum at all times while it is in operation.
- The Saf-T-Driver hoist line must be kept free of slack and kinks. Daily inspection of wires for fraying must be maintained.

4.2.10 Safe Operation of Drill Rigs in Landfills

Landfill drilling presents a fire/explosion hazard. Pockets of methane or other flammable/explosive materials may be encountered. Because of this, there is the potential for surface or downhole fires or explosions. To control the hazard:

- The drill rig should be diesel powered and equipped with a spark-arresting muffler.

- Explosive gases should be monitored as continuously as possible using an explosimeter and oxygen meter. The meter should be kept on the rig at all times during intrusive activities (see Section 4.3.7 of this SOP).
- LEL readings in and around the borehole shall be immediately evaluated. Direct-reading instruments and/or colorimetric tubes may be used to determine the presence of organic vapors and toxic gases. Refer to the site-specific Health and Safety Plan (HSP) for project action levels.
- The rig and all ignition sources shall be placed upwind or crosswind from the borehole.
- The borehole shall be saturated with water where feasible to reduce the risk of downhole explosions.
- If explosive gases exceed 10% LEL at a radius of 5 feet outside the borehole, drilling operations should cease; crews should be placed on standby until levels are reduced by natural wind ventilation. If the % LEL does not decrease to a safe level, then at least one of the following suppression/dissipation techniques shall be implemented to reduce levels:

    - While the rig is operational, a high-capacity fan can be used to aid the wind in dissipating escaping gases and/or vapors from the borehole. Fans will have explosion-proof wiring or be powered by a diesel-operated generator. Under no circumstances should air be directed into the borehole.
    - While the rig is operational, a fire-suppressant foam such as AFFFä may be used to reduce the potential for sparking or flare-ups. However, this technique requires the use of containment dikes, and protective coveralls and gloves, and is not recommended for use under windy conditions. The Material Safety Data Sheet (MSDS) for this foam and all chemicals brought on-site must be kept on-site with the site-specific HSP.
    - While the rig is not operational, an inert gas (such as nitrogen or carbon dioxide) purging system should be used to displace methane gas. The inert gas should be introduced to the base of the borehole with 1/4-inch copper tubing, at a rate of approximately 40 pounds per square inch gauge (psig). Subsequent gas/vapor readings and the inerting gas regulator inspections shall be performed in Level B (supplied air) to ensure personnel safety.

4.3 Administrative Controls

4.3.1 Training

All personnel working on a hazardous waste site in the proximity of an operating drill rig and the support equipment shall be thoroughly familiar with the operational hazards involved and shall have completed the OSHA 29 CFR 1910.120 *Hazardous Waste Operations and Emergency Response* (HAZWOPER) training and annual updates, if applicable. Hearing conservation and personal protective equipment (PPE) training shall be covered either as part of the HAZWOPER training, or in separate sessions. Support equipment includes grout plants, pumps, and powered earth-moving equipment such as bulldozers, backhoes, etc.

For work taking place on nonhazardous waste sites, hearing conservation and respiratory protection training, as well as a thorough familiarity with the drill rig and support equipment, are required.

Subcontractors shall be responsible for ensuring that their employees receive proper training in safe drilling operation, HAZWOPER (as applicable), hearing conservation, and personal protective equipment to limit the potential for job-related injuries/illnesses.

Training requirements are also discussed in Volume IV, Training Program, of this manual.

Training shall be documented and a copy of the training certificates shall be placed in the employee personnel or health and safety records.

4.3.2 Medical Surveillance

Personnel who are required to work on hazardous waste sites or wear respiratory protection will have completed a baseline and/or periodic physical, and exit physical examination, as necessary, in accordance with OSHA 29 CFR 1910.120 *HAZWOPER*, and/or 29 CFR 1910.134, *Respiratory Protection*. Documentation should be placed in employee personnel or health and safety records. Refer to Volume III, Medical Surveillance Program, of this manual.

Because hearing protection is needed to protect from high noise levels around drill rigs, workers will receive baseline and annual audiograms, as required by 29 CFR 1910.95, *Occupational Noise*, and SOP H-10, *Hearing Conservation Program*.

Subcontractors shall provide the necessary medical surveillance for their employees working on AEE projects.

4.3.3 Personal Protective Equipment

The following PPE shall be worn:

- At a minimum, hard hats, safety-toe work boots/shoes, safety glasses, and work gloves shall be worn by all workers.
- Ear protection devices such as ear plugs, ear muffs, or plugs and muff combinations shall be worn, as required.
- Chemical protective clothing, goggles, and an air purifying respirator fitted with a dust filter shall be worn by all personnel handling cement grout during grouting.
- Additional protective equipment requirements for HAZWOPER projects will be covered in the site-specific HSP.
- All protective equipment shall be provided by respective employer(s).
- Worn, damaged, or excessively soiled equipment shall be replaced as required.

Refer to SOP H-12, *Personal Protective Equipment*, for additional information.

4.3.4 Eating, Drinking, Chewing, or Smoking

To limit the potential for ingestion of contaminants:

- Eating, drinking, chewing, or smoking is not allowed on any drill rig or in any restricted zone.
- A break area shall be set up with hand and face washing provisions in the Support Zone.

- Before eating, drinking, or smoking, all personnel shall thoroughly wash their hands and face. Soap and water shall be supplied for this purpose.
- Alcoholic beverages and drugs of any type shall not be consumed at any time during the work day. In addition, any employee suspected of being under the influence of drugs or alcohol at any time during the work day will be removed from the site.

4.3.5 Equipment Safety Inspections

The subcontractor supervisor (or designee) will be responsible for ensuring the inspection of all machinery and equipment within 3 days prior to its use on-site and before daily use to make sure it is in safe operating condition. In most cases the competent individual inspecting will be the subcontractor, owner, or operator. The Machinery and Mechanized Equipment Certification form (provided as Attachment 5) shall be submitted to the FM upon completion. Drill rigs and related support equipment and vehicles shall be inspected by the driller-in-charge on a daily basis. Inspections will be made to determine that the brakes, lights, alarm systems, exhaust system, operating systems, drill rig controls, and any emergency shut-off controls are in proper working condition. All hydraulic lines and fittings shall be free from wear and damage, and cable systems and pull ropes shall be properly installed and free from fraying and other damage. For drill rigs, all inspections will be documented on the Daily Drill Rig Checklist (Attachment 4) or equivalent subcontractor forms. The drilling operator will complete the Daily Drill Rig Checklist or equivalent and submit it to the SHSC. The SHSC shall enforce the equipment inspections.

Verification of inspection deficiencies and corrective action shall be recorded daily in the field log book by the FM. Any machinery or equipment found to be unsafe by the subcontractor supervisor or SHSC will be taken out of service and its use prohibited until unsafe conditions have been corrected. Preventive maintenance shall be conducted for all equipment according to the subcontractor's internal policies, schedules, and equipment SOPs. Only preventive maintenance procedures recommended by the manufacturer will be followed.

Should the operator observe any equipment deficiencies at any time that affect safe operation, they will be corrected before continuing operation.

All running ropes (wire ropes), shackles, and tow hooks that are in continuous service shall be visually inspected once each day for:

- distortion such as kicking, crushing, unstranding
- birdcaging, main-strand displacement, or core protrusion
- general corrosion
- broken or cut strands (must be covered or blunted)
- number and type of visible broken wires (in any length of 8 diameters, the number of visible broken wires must be less than 10% of the total number of wires)
- core failure in rotation-resistant ropes
- any other condition relative to the rope that may cause rope failure

Common wire rope damage is discussed in SOP S-15, *Ropes, Slings, Chains, and Accessories*.

These practices serve as a basic guide and do not encompass all pertinent safety-related regulations. Subcontractors are responsible for full compliance with all applicable laws, ordinances, rules, and regulations of federal, state, and local authorities regarding project activities.

4.3.6 Operator Qualifications

Machinery and mechanized equipment will be operated only by qualified personnel, in accordance with the procedures set forth in OSHA 29 CFR 1910.178, P*owered Industrial Trucks* and 29 CFR 1926.20, *General Safety and Health Provisions*. All heavy equipment operators will demonstrate their proficiency on the equipment prior to actually beginning work on-site.

4.3.7 Air Monitoring

To lower the potential for employee and public overexposure and for fire and explosion, air monitoring shall be performed at regular intervals as specified in the site-specific HSP. Readings will be documented on forms provided in the site-specific HSP. In general:

- Explosivity may be monitored at the rig continuously; a meter may be placed on the rig as close to the borehole (source) as feasible.
- Toxics and explosivity may be monitored at the site perimeter, in the breathing zone of workers, and in the general work area at least once per hour, or as specified in the site-specific HSP. Monitoring will also be conducted with any change in site conditions or marked increases in previous readings, and/or at the discretion of the SHSC.
- Background monitoring will be conducted prior to the initiation of site activities each day, and upon mobilization of the drill rig to a new location.

5.0 Records

The Machinery and Mechanized Equipment Certification form (Attachment 5) and Daily Drill Rig Checklist (Attachment 4) must be completed to comply with this procedure.

6.0 References

1. Fed-OSHA. 2000. 29 CFR 1910, *General Industry Standards*.
2. Fed-OSHA. 2000. 29 CFR 1926, *Construction Industry Standards*.
3. Fed-OSHA. 2000. 29 CFR 1910.95, *Occupational Noise*.
4. Fed-OSHA. 2000. 29 CFR 1910.120, *Hazardous Waste Site Operations and Emergency Response*.
5. Fed-OSHA. 2000. 29 CFR 1926.152, *Flammable and Combustible Liquids*.
6. Valley Well Drilling. 1995. Technical Approach to Drilling, Sampling, Monitor Well Installation, and Well Development.

Sampling Equipment, Heavy Equipment, and Vehicle Decontamination

1.0 PURPOSE

The purpose of this procedure is to provide standard decontamination methods for use during project activities at sites potentially contaminated with hazardous materials/wastes. The removal of waste-laden materials and surface contamination from sampling equipment, heavy equipment, and vehicles is necessary because, once complete, it permits unrestricted use of the equipment by AMEC Earth & Environmental, Inc. (AEE) and subcontractors, full movement of the equipment in the clean areas of the site, and for relocation off-site. An additional benefit is that once decontamination is complete, only the need for basic safety equipment remains (e.g., safety-toe boots, hard hat, and safety glasses).

There are chemical and physical hazards associated with decontamination activities. The purpose of this standard operating procedure (SOP) is to ensure personnel safety during the decontamination process. Personnel decontamination is addressed in SOP H-6, *Personnel Decontamination*.

2.0 SCOPE

This procedure applies to all AEE employees and subcontractors where applicable during decontamination of sampling equipment, heavy equipment, and vehicles, as delineated in site-specific Health and Safety Plans (HSPs).

3.0 DEFINITIONS

Deconnable Surfaces - Deconnable surfaces are nonporous surfaces incapable of absorbing contaminants. Deconnable surfaces include metal, glass, and high density plastics or polymers.

Decontamination - Decontamination is defined as the process of physically removing contaminants or changing their chemical nature to innocuous substances.

Exclusion/Hot Zone - The Exclusion or Hot Zone (EZ) is defined as the area where contamination is the greatest. It encompasses a 30-foot radius around intrusive activities with access restricted to field sampling crews and necessary equipment operators.

Transition Zone - The Transition Zone (TZ) is defined as the area between the EZ and Contamination Reduction Zone (CRZ). It should be established upwind of the EZ and serve as the support area for sample quality assurance/quality control (QA/QC) and packing. Any coolers that are in this zone should be protected from contamination using polyethylene sheeting and decontaminated prior to leaving the site.

Contamination Reduction Zone - The CRZ is defined as the area between the TZ and the Clean or Support Zone (SZ). Consisting of two separate decontamination lines, this is the area where both equipment and personnel are decontaminated in order to prevent the spread of contamination. The CRZ should be marked as narrow corridors through which personnel and equipment pass from work zones to the SZ.

Clean/Support Zone - The SZ is defined as the area of no contamination. It is upwind and away from the EZ and serves as the location where vehicles, emergency equipment, telephones, break areas, and all non-essential personnel remain.

4.0 RESPONSIBILITIES

4.1 Project Manager

The Project Manager (PM) is responsible for identifying instances of noncompliance with this procedure and ensuring that future field activities are in compliance with this procedure.

4.2 Field Manager

The Field Manager (FM) will ensure that this procedure is implemented correctly. The FM will also ensure that decontamination effectiveness is evaluated, as necessary.

4.3 Site Health and Safety Coordinator

The Site Health and Safety Coordinator (SHSC) is responsible for ensuring that decontamination occurs according to this procedure.

4.4 Corporate Safety, Health, and Environment Director

The Corporate Safety, Health, and Environment Director (Corporate SHE Director) is responsible for ensuring that this procedure reflects the current scientific practices in the area of equipment and vehicle decontamination.

5.0 PROCEDURES

Before any work begins on a hazardous waste site, decontamination of equipment should be addressed in the HSP. The decontamination section of the HSP should:

- determine the number and layout of decontamination stations
- determine the decontamination equipment and solutions needed
- determine appropriate decontamination methods
- establish procedures to prevent contamination of clean areas
- establish methods and procedures to minimize worker contact with contaminants during equipment or vehicle decontamination

The decon plan should be revised whenever site conditions change or site hazards are reassessed based on new information.

The following subsections describe standards for decontamination.

5.1 Equipment and Vehicle Decontamination Area

An appropriate location for sampling equipment, heavy equipment, and vehicle decontamination at a site shall be selected based on the ability to control access to the area, control residual material removed from equipment, store clean equipment, and gain entry and exit for vehicles. The decontamination area shall be located at an adequate distance away and upwind from potential contaminant sources to avoid contamination of clean areas and personnel (usually in the CRZ), and separate from the personnel decontamination area. Once equipment and vehicles are clean, they shall be moved to a clean area or stay at a sufficient distance from the potential contamination sources and the decontamination area to ensure that they remain clean. Work zones are shown in Attachment 1.

5.2 Cleaning Solutions, Equipment, and Techniques

The preferred method of sampling equipment decontamination involves the use of long-handled, soft-bristled brushes, galvanized wash tubs or equivalent with secondary containment, pump-activated sprayer, buckets with plastic liners and drums with liners, visqueen, a mild detergent solution, and an appropriate solvent (usually isopropyl alcohol) in a spray bottle. Lumber and/or coolers/crates/boxes are preferred for elevating sampling equipment decon buckets. Detergents are preferred over other cleaning solutions because the detergent alone does not pose a handling or disposal problem (see Attachment 2). The more commonly used solutions are Penetone 155, in cases where polychlorinated biphenyls (PCBs) are of concern, and Liquinox or Alconox for general decontamination purposes. Material Safety Data Sheets (MSDSs) for decon solutions must be appended to the site-specific HSP.

Equipment and vehicle decontamination is accomplished using a variety of equipment, techniques, and solutions. A list of the necessary decontamination supplies for equipment and vehicles is as follows:

- personal protective equipment (PPE) (see below)
- high-pressure water sprayer: for washing and rinsing heavy equipment and vehicles (or equivalent decon fluid delivery device), or pressurized pump spray canister for final rinse of sampling equipment
- hazard tape (black and yellow) for marking heavy equipment and vehicles before release
- appropriate decon solution (water, dilute acids or bases, detergent-based surfactants, organic solvents)
- appropriate rinse solution (usually water)
- curtains, enclosures, or spray booth to contain splashes and blow back from high-pressured sprayers for heavy equipment and vehicle decontamination: visqueen plastic sheets or rolls, lumber
- containment to hold contaminants and solutions: assorted booms, lumber, duct tape (for temporary containment)
- assorted rags, long-handled brushes, shovels, hand tools, buckets (for exterior and cab decon, and submersion of sampling equipment)
- storage tanks or drums for appropriate treatment systems to provide temporary storage and/or treatment of contaminated wash and rinse solutions
- drains or pumps for collection of contaminated wash and rinse solutions
- containers for storage and disposal of contaminated wash and rinse solutions, damaged or heavily contaminated parts, and porous, nondeconnable materials to be discarded

Attachment 3 shows the preferred setup for the sampling equipment decontamination area and the heavy equipment decon area.

5.3 Personal Protective Equipment

Generally, Level Modified D or C PPE will be required for those personnel performing decontamination. The level of PPE for decon is stated in the HSP and is typically equivalent to or slightly less than the PPE required by personnel who enter the EZ. The SHSC will require upgrading or permit downgrading when evidence allows the determination of airborne or surface contamination. This upgrade or downgrade will be determined by the SHSC through visual inspection and/or air monitoring for the contaminant of concern. The SHSC will inform the decon staff when it is acceptable to downgrade the PPE.

The HSP will identify the proper canister or filter for use with Level C respiratory protection based upon the contaminants known or suspected to occur at the site.

5.4 Sampling Equipment Decontamination Procedure

1. Assemble the appropriate decon equipment and PPE for use during your shift.
2. Prepare the appropriate decon wash and rinse solution(s) for use. This may consist of diluting an acid, base, surfactant, or detergent to a suitable concentration. Be sure to refer to the applicable MSDS, if available before commencing.
3. Carefully remove AS MUCH contaminated material AS POSSIBLE manually using shovels, rods, trowels, brushes, etc., from the exterior and interior of the equipment to be deconned, allowing the material to fall onto a visqueen-coated surface or into an empty bucket.
4. Immerse the equipment in the first decon bucket containing the decon solution. The fluids must be contained by secondary buckets containing the decon buckets (temporary or permanent). Tenting may have to be utilized in order to prevent the blowing of contaminant-laden droplets into a clean area.
5. Immerse the entire piece of sampling equipment in the appropriate rinse solution in the second bucket.
6. Spray the piece of equipment with the solvent, as necessary.
7. Place the equipment in the third bucket for the final rinse.
8. Follow with a spray of deionized water from a pressurized sprayer.
9. Dispose of all nondeconnable materials in a suitable manner. This may consist of placing the materials in appropriate containers or moving the materials to a designated portion of the waste feed pile for eventual treatment and/or incineration.

NOTE: In some instances it may be necessary to use an additional wash/soap solution bucket before equipment is sent through the decon line.

5.5 Controls for Chemical and Physical Hazards

The following standard practices will help to control the physical and chemical hazards of the decon procedure:

- elevate sample buckets to prevent back strain due to bending and stooping
- perform decontamination with steady motions that utilize the natural angle of the body's wrists, fingers, hands, arms, neck, and back
- use hand-powered pump spray devices rather than triggered spray bottles
- transport drums on a drum dolly to the location of the decon wastewater (buckets or bermed pad) rather than carry buckets to the drum storage area for disposal of wastewater, or place lids on the buckets and move the buckets by an appropriate method
- rotate personnel on job tasks to minimize the effects of heat exposure and ergonomic trauma
- wear appropriate PPE (as specified in the HSP), such as gloves, Tyvek®, and safety glasses to protect from chemical exposure during decon
- stand upwind of the spray stream of solvent to avoid inhalation and skin contact
- stand upwind of the decon line or the equipment being deconned to avoid being splashed by liquid spray that may contain contaminated materials

5.6 Heavy Equipment or Vehicle Decontamination Procedure

1. Assemble the appropriate decon equipment and PPE for use during your shift.

2. Prepare the appropriate decon wash and rinse solution(s) for use. Decon solutions may include water, dilute acids or bases, surfactants, or detergents. Be sure to refer to the applicable MSDS, if available before commencing.
3. Drive the vehicle onto or place the heavy equipment on the decontamination pad.
4. Carefully remove AS MUCH contaminated material AS POSSIBLE manually using shovels, rods, trowels, brushes, etc., from the exterior and interior of the equipment to be deconned, including the cabs of vehicles.
5. Using a high-pressure sprayer or other equivalent liquid delivery device, carefully wet down the vehicle or heavy equipment with the appropriate decon solution. Care should be taken to remove as much visible contamination as possible utilizing the minimal amount of liquids. The fluids must be contained by berms (temporary or permanent). Plastic sheeting may have to be erected in order to prevent the blowing of contaminant-laden droplets into a clean area. The decon washings must drain into a collection device (grate with sump or holding tank).
6. If deconning a vehicle, pull the vehicle slightly forward and decon the part of the tire that was in contact with the ground that had not been previously deconned. Wash the contaminated material away from the deconned vehicle so as not to recontaminate.
7. Rinse the entire vehicle or piece of heavy equipment with the appropriate rinse solution, as necessary.
8. Mark the deconned vehicle or heavy equipment with Hazard Tape (black and yellow stripe) or use a Decon Inspection Ticket (Attachment 4). This will signify to the SHSC which equipment needs to be released.
9. Contact the SHSC for release. The SHSC may release by visual inspection (in event of low health hazard) or by wipe testing (in event of moderate to high health hazard). The SHSC will remove the Hazard Tape or sign off on the Decon Inspection Ticket (Attachment 4) when the vehicle or equipment is released.
10. Dispose of all non-deconnable materials in a suitable manner. This may consist of placing the materials in appropriate containers or moving the materials to a designated portion of the waste feed pile for eventual treatment and/or incineration.

5.7 Efficiency Testing

The SHSC will evaluate all decontamination activities for completeness. This may consist of visual inspections, decon solution analysis (e.g., for pH), or surface wipe testing if the contaminant can be detected in this manner. With a standard wipe test, a standard-size template (usually 10 centimeter X 10 centimeter) is used to delineate the area to be wipe tested. The wiping media generally consists of glass wool (or equivalent) and a suitable solvent. At the completion of the test, the sampling media is placed carefully into a glass vial, sealed, marked, and submitted for analysis. The SHSC will receive the wipe test analytical data from the analytical laboratory.

5.8 Release Criteria

All wipe test results will be reviewed by the SHSC for comparison to a recognized standard. This standard may be derived from regulatory dictates (i.e., USEPA and PCBs), agency recommendations (i.e., Dept. of Health Services and total hydrocarbons), or from good industrial practices (i.e., pH between 6 and 8, visually clean).

At the time of release, the SHSC will remove the Hazard Tape or Decon Inspection Ticket (Attachment 4) signifying that the released vehicle or equipment is fully decontaminated and available for uncontrolled movement and usage.

6.0 REFERENCES

1. NIOSH/OSHA/USCG/USEPA. 1985. Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities. October.

Personal Protective Equipment

1.0 PURPOSE

The purpose of this procedure is to inform AMEC Earth & Environmental, Inc. (AEE) personnel of the requirements of and methods for the selection, use, and maintenance of personal protective equipment (PPE). The objectives include:

- ensuring compliance with federal Occupational Health and Safety Administration (OSHA) regulations in 29 CFR and applicable state regulations
- minimizing the risk of human injury and illness caused by exposure to chemical, physical, biological, and energy hazards that may be encountered at a project site
- reducing potential corporate liability incurred by employees using inadequate or improper PPE

See also AEE standard operating procedures (SOPs) H-13, *Respiratory Protection Program;* A-7, *Personal Protective Equipment Issuance*; H-7, *Facial Hair Policy*; H-10, *Hearing Conservation Program*; H-3, *Cold Stress Control*; H-9, *Heat Stress Control*; and S-7, *Fall Protection and Prevention*.

2.0 SCOPE

This procedure applies to AEE personnel and subcontractors who may work on or visit AEE jobsites and applies to all projects and activities that may require the use of PPE.

3.0 DEFINITIONS

ACGIH - American Conference of Governmental Industrial Hygienists.

Action Level - Specifications taken based on instrument readings. Specific actions may include upgrading/downgrading levels of protective equipment, stopping work, or evacuating a site.

Field Activities - Activities performed by any employee of AEE (e.g., environmental scientists, engineers, marine scientists, geologists and geotechnical technicians, biologists, etc.) at a field site. Field activities generally include, but are not limited to, such tasks as soil boring and sampling, well installation and sampling, underground storage tank (UST) removal, wastewater sampling, building and facility sampling and decommissioning, soil excavation, and construction and operations of soil and groundwater treatment systems. Other field activities may include site visual inspections for lead-based paint, asbestos, polychlorinated biphenyls (PCBs), and/or other contaminants; air monitoring; and on-site analyses of soil, groundwater, and air samples.

Field Work - Work performed as part of field activities and at a site away from the main office. Field work is generally performed outdoors but may take place within site buildings and facilities.

Immediately Dangerous to Life or Health (IDLH) - Conditions that pose an immediate threat to life or health (toxic, explosive, etc.) or conditions that pose an immediate threat of severe exposure to contaminants such as radioactive materials, which are likely to have an adverse cumulative or delayed effect on health. Also, the maximum concentration from which, in the event of respiratory failure, one could escape within 30 minutes without a respirator and without experiencing any escape-impairing or irreversible health effects.

Injurious Nonionizing Radiation - Ultraviolet, infrared, and visible light.

Occupational Safety and Health Administration (OSHA) - A division of the U.S. Department of Labor.

Permissible Exposure Limit (PEL) - PELs are set forth in OSHA Standards 29 CFR 1910 and 29 CFR 1926. As part of the regulations, PELs represent the legal maximum airborne concentrations for personal exposure. The PEL list is not updated annually, as is the Threshold Limit Value (TLV; see below) list compiled by ACGIH; therefore, the most current ACGIH TLV list is used rather than the OSHA PEL listing to determine respiratory protection, unless the PEL value (federal, or state where applicable) is more conservative.

Personal Protective Equipment (PPE) - In this SOP, PPE shall refer to protective equipment, protective clothing, and respiratory protection.

Subcontractor - Any other firm contracted to perform services for AEE. Subcontractors generally involved in field projects include, but are not limited to, heavy equipment operation, drilling and well installation firms, geotechnical consultants, analytical firms, and outside health and safety professionals.

Threshold Limit Value (TLV) - The TLV is recommended by the ACGIH and is derived from consensus review. It is reported as a time-weighted average (TWA) airborne concentration for a particular substance. It represents a level that most workers can be exposed to for an 8-hour day (40-hour week) without suffering adverse health effects. The TLV assumes that each 8-hour exposure will be followed by a 16-hour recovery period and that after 5 days, there will be a 48-hour recovery period. The TLV lists are published by ACGIH yearly. Each specific TLV is reviewed at least once every 3 years to incorporate new scientific information.

4.0 RESPONSIBILITIES

The Project Manager (PM); Corporate Safety, Health, and Environment Director (Corporate SHE Director); Field Manager (FM); Site Health and Safety Coordinator (SHSC); and Safety, Health, and Environment Coordinator (SHE Coordinator) are responsible for ensuring compliance of this procedure by all field personnel.

4.1 Project Manager

The PM is responsible for incorporating the requirements of this procedure into project plans, budgets, and activities.

4.2 Corporate Safety, Health, and Environment Director

It is the responsibility of the Corporate SHE Director or local technically knowledgeable designee to ensure that this procedure complies with federal and state OSHA guidelines.

4.3 Project Manager

The Project Manager (PM) will ensure that the subcontractor receive the PPE requirements as outlined in the site-specific health and safety plan (HSP). Further, the PM will convey that the provision of PPE is the responsibility of the subcontractor for their employees.

4.4 Field Manager

The FM must ensure that all personnel are aware of the PPE requirements as identified in the site-specific HSP. In addition, he/she must have a plan of action that lists requirements in the event of a PPE upgrade.

Should a PPE upgrade be necessary, the FM must notify all personnel and visitors and evacuate the work area of the site. The FM oversees all upgrade activities.

4.5 Site Health and Safety Coordinator

The SHSC is responsible for implementing and enforcing this procedure as directed by the HSP during project operations and activities. The SHSC also determines the appropriateness of assigned PPE levels based on site conditions and the results of air monitoring. The SHSC also provides training in the proper use of PPE; ensures that an adequate supply of PPE is available and used by employees; and arranges for proper maintenance, decontamination, storage, and issuance of all required PPE.

4.6 SHE Coordinator

The SHE Coordinator is responsible for implementing and enforcing this procedure as it pertains to work activities that occur in the office or laboratory. The SHE Coordinator shall evaluate work tasks, select PPE, issue PPE, and provide training.

4.7 All Employees

All employees of AEE performing activities that require the use of PPE must comply with this procedure.

4.8 Subcontractors

All personnel subcontracted to AEE and working on a field project are subject to the requirements of this procedure along with internal procedures set forth by the subcontracting company. Provision of PPE shall be the responsibility of the subcontractor for their employers.

5.0 PROCEDURE

Appropriate PPE shall be supplied and properly used for all AEE operations where hazardous substances or other hazardous conditions (environmental or operational) may be encountered. Subcontractor personnel shall provide their own PPE and shall maintain adequate supplies on-site for specified levels of protection, including the potential upgrades listed in the site-specific HSP. The PM and/or SHSC shall review subcontractor equipment and ensure that it meets the requirements as specified in the HSP.

The choice of PPE for each project will be based on the specific hazards identified. Hazards will be identified in office or facility situations using a Hazard Assessment and PPE Selection form (Attachment 1). Field hazards will be identified during preliminary hazard evaluations and site characterizations, as described in Volume II, Comprehensive Field Project Health and Safety Program, of this manual. Appropriate PPE will be specified in the field project site-specific HSP. The procedures and guidelines for the proper selection and use of PPE follow.

5.1 Heat Stress and PPE

Heat stress arises when the combination of ambient air temperature, relative humidity, solar load, and wind speed hinder the human body's ability to thermoregulate. Heat stress is also a major hazard for workers wearing chemical-protective clothing, particularly in warm and humid environments. Protective materials that shield the body from chemical exposure also prevent heat and moisture generated by the body from dissipating. PPE can therefore rapidly create a hazardous condition because the body can no longer thermoregulate properly. Work tasks, climatic conditions, and the level of PPE must be taken into consideration as best as possible to manage heat stress. Please refer to SOP H-9, *Heat Stress Control*, for additional information about heat stress management.

5.2 Provisions for PPE

As stipulated in OSHA regulations for PPE (29 CFR, Section 1910.132-1910.137), AEE shall provide employees with protective clothing (e.g., chemical protective pants, hooded jackets and coveralls, gloves, hard hats, hearing protection, respirators, electrical protective equipment, heat/cold stress prevention gear, safety glasses, fall protection, flotation devices, boots) to protect their health and welfare from hazards capable of causing injury or impairment in the function of any part of the body through absorption, inhalation, or physical contact. The provisions for safety-toe footwear and prescription safety eyewear are addressed in SOP A-7, *Personal Protective Equipment Issuance (Safety-toe Boots/Shoes and Glasses)*. The Corporate SHE Director, SHSC, and SHE Coordinator will ensure that the PPE is applicable and suitable for the working environment and the specific hazards known or suspected to exist.

5.3 Selection of PPE

Selection of appropriate PPE will be based upon the physical, chemical, biological, and energy hazards present in the work area or on-site after engineering and administrative controls have been considered.

5.3.1 Office Work Environment

For office or facility situations, once the hazard assessment portion of the Hazard Assessment and PPE Selection form (Attachment 1) is complete, the appropriate kind and type of PPE can be selected based upon information provided on the Material Safety Data Sheet (MSDS) instructions, or consultation with the Corporate SHE Director or local designee.

5.3.2 Field Work Environment

PPE selection for site work is documented in the site-specific HSP (see Volume II, Comprehensive Field Project Health and Safety Program, of this manual for an example) or on a Hazard Assessment and PPE Selection form (Attachment 1).

Levels of protection (A, B, C, D, and Modified D) that comply with 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response*, are selected based upon:

- type of chemical substance in the ambient atmosphere, its measured concentration, and its toxicity
- potential for exposure to splashes of liquids, substances in the air, or other direct contact with material while working
- knowledge of the expected chemicals of concern and their properties, such as toxicity, route of exposure, and so forth

Items such as electrical protective equipment, fall protection equipment, hearing protection, heat and cold stress protection, life jackets, and eye protection are considered types of PPE but are not classified as a particular level of protection.

5.4 Levels of Protection for Hazardous Waste Site Work

The U.S. Environmental Protection Agency (USEPA) Office of Emergency and Remedial Response specifies four ensembles of protective clothing and equipment for uncontrolled hazardous waste site work (Levels A, B, C, and D). AEE utilizes a fifth level of protection, Modified Level D (Mod. D).

No single combination of protective equipment and clothing can protect against all hazards; therefore, PPE should be used in conjunction with other methods of protection (after administrative and engineering control options have been considered), and its effectiveness should be evaluated periodically.

The levels of protection indicate the degree of protection recommended for generalized categories of hazardous environments and are as follows:

Level A Protection should be worn when the highest level of respiratory, skin, and eye protection is needed. Level A is generally used where extremely hazardous substances are known to be present in high atmospheric concentrations and where Level B splash gear does not offer adequate protection against any dermally active substances present or where materials and concentrations are unknown. This level is also used where the absence of conditions requiring Level A have not yet been determined. See Attachment 2 for an example of Level A protection. Level A protection includes:

- positive pressure, full-facepiece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA, approved by the National Institute for Occupational Safety and Health (NIOSH)
- totally encapsulating chemical-protective suit, taped to boots and gloves
- coveralls*
- long underwear*
- gloves, outer, chemical-resistant
- gloves, inner, chemical-resistant
- safety-toe boots, chemical-resistant
- hard hat (under suit)*
- disposable protective suit, gloves, and boots (depending on suit construction, may be worn over totally encapsulating suit)

* Optional, as applicable

Level B Protection should be worn when the highest level of respiratory protection is needed, but a lesser level of skin protection. Level B is generally used in those situations where the type and atmospheric concentration of substances have been identified and require a high level of respiratory protection. Examples of these types of atmospheres include IDLH concentrations of a specific substance that does not pose a severe skin hazard, or conditions where the criteria for use of air purifying respirators have not been met. This level of protection is normally the minimum used for initial emergency response or initial site reconnaissance, unless the respiratory hazards allow for a lesser level of respiratory protection than an SCBA. See Attachment 3 for an example of Level B protection. Level B protection includes:

- positive pressure, full-facepiece SCBA, or positive pressure supplied air respirator with escape SCBA (NIOSH-approved)
- hooded chemical-resistant clothing (overalls and long-sleeved jacket, coveralls, one- or two-piece chemical-splash suit, disposable chemical-resistant overalls) taped to boots and gloves
- coveralls*
- gloves, outer, chemical-resistant
- gloves, inner, chemical-resistant
- safety-toe boots, outer, chemical-resistant
- boot covers, outer, chemical-resistant (disposable)*
- hard hat*
- face shield*

* Optional, as applicable

Level C Protection is composed of skin protection and an air-purifying respirator. Level C provides adequate protection when the type of airborne substance is known, the concentrations have been measured, the criteria for using air-purifying respirators are met, and the dermal route of exposure is not acutely hazardous. Use of this level of protection requires continuing measurement of air contaminants to

ensure that IDLH concentrations do not arise or exist and that the concentrations of the contaminants present do not exceed the service limits of the respirators. See Attachment 4 for types of Level C respiratory protection. Level C protection includes:

- full-face or half-face air-purifying respirator (NIOSH-approved) fitted with appropriate cartridges or filters
- hooded chemical-resistant clothing (overalls and long-sleeved jacket, coveralls, one- or two-piece chemical-splash suit, or disposable chemical-resistant overalls) taped to boots and gloves
- coveralls*
- gloves, outer, chemical-resistant
- gloves, inner, chemical-resistant
- safety-toe boots, outer, chemical-resistant*
- boot covers, outer, chemical-resistant (disposable)*
- safety glasses or chemical splash goggles (with half-mask)*
- hard hat*
- escape mask*
- face shield*

* Optional, as applicable

Various types of air-purifying cartridges are available for use with air-purifying respirators. Each cartridge will protect against exposure to a specific class of air contaminants. The concentration limitation for each type of cartridge is stated on each cartridge box. The cartridges currently available protect against the following:

- acid gases
- hydrocyanic acid gases
- chlorine gases
- organic gases
- ammonia gases
- organic vapors and acid gases
- hydrocyanic acid gas and chloropicrin vapor
- acid gases, organic vapors, and ammonia gases

In addition, there are specific filters to protect against the following:

- radioactive materials, except tritium and noble gases
- particulates (dusts, fumes, mists, fogs, or smokes) in combination with any of the above gases or vapors

The Corporate SHE Director and SHSC shall select the proper cartridge for use with Level C respiratory protection based upon the contaminants known or suspected to occur at the site. SOP H-13, *Respiratory Protection Program*, of this manual provides guidelines on respiratory protection selection.

Modified Level D Protection is an AEE-specific level of PPE to be worn on sites with dermal skin hazards but no respiratory hazards. Modified Level D provides adequate protection when the type of airborne substance is known, its concentrations are measured, no protection is required, and the dermal route of exposure is not acutely hazardous. Use of this level of protection requires continuing measurement of air contaminants to ensure that IDLH concentrations do not arise or exist. See Attachment 5 for an example of Modified Level D protection. Modified Level D protection includes:

- work shirt and full-length cotton pants or coveralls

- chemical-resistant clothing (overalls and long-sleeved jacket, coveralls, one- or two-piece chemical-splash suit, disposable chemical-resistant overalls) taped to boots and gloves
- gloves, outer, chemical-resistant
- gloves, inner, chemical-resistant
- safety-toe boots/shoes, chemical-resistant (disposable) boot covers or safety-toe rubber boots
- safety glasses or chemical splash goggles
- hard hat*
- escape mask*
- face shield*

* Optional, as applicable

Level D Protection is primarily a work uniform affording minimal protection and is used for nuisance contamination only. This level is used when there is no indication of hazardous atmospheres and the work function precludes contact with any hazardous level of chemicals. Level D protection includes:

- work shirt and full-length cotton pants or coveralls
- gloves*
- safety-toe boots/shoes
- boots, outer, chemical-resistant (disposable)*
- safety glasses or chemical splash goggles
- hard hat*
- escape mask*
- face shield*

* Optional, as applicable

5.5 Use of PPE for All Field Projects and Work Tasks

For both nonhazardous and hazardous waste field projects and for office or facility work tasks, the SHE Coordinator or SHSC shall ensure that all PPE is used for the specific site conditions and activities for which it was intended and shall enforce procedures for the use of PPE, as specified in the site-specific HSP or Hazardous Assessment and PPE Selection form (Attachment 1). In addition, the SHE Coordinator or SHSC shall ensure that the following requirements for using PPE are met.

5.5.1 General Requirements

- No person will be allowed to enter a contaminated area or controlled work zone without the proper PPE, as specified in the site-specific HSP or Hazard Assessment and PPE Selection form.
- PPE requirements for work in contaminated areas may be downgraded or upgraded only upon approval of the SHSC and/or regional SHE Manager, or by Action Levels set in the site-specific HSP. Decisions to upgrade or downgrade must be based on environmental monitoring or other conditions that indicate greater or lesser exposure hazards than those originally anticipated.
- Adequate training in proper PPE use will be given to all AEE personnel. The training shall include a summary of correct PPE use procedures; capabilities and limitations of PPE; donning, doffing, cleaning, and fitting PPE; emergency escape procedures; the nature of respiratory and other hazards; and what will happen if PPE is not used properly. Personnel

required to wear PPE will also be allowed to wear the equipment in an uncontaminated area to become familiar with it. They should be informed of the chemical cartridge change schedule, warnings that indicate respirator cartridges are saturated, or warnings that garments are inoperative. This information is also covered in the Hazardous Waste Operations and Emergency Response (HAZWOPER) course, which must be completed before an employee can be assigned to a hazardous waste site.

- All PPE must be checked by the wearer daily before each use and while cleaning it. The user should ensure that it is not cracked, torn, or distorted; has no pinholes; and is in proper working condition.
- Reusable PPE shall be capable of being cleaned easily and disinfected. PPE shall be kept clean and in good condition. PPE shall not be interchanged by employees until properly cleaned.

5.5.2 Head Protection

Hard hats must be worn by employees working in areas where there is danger of head injury from impact, from falling or flying objects, or from electrical shocks or burns. Helmets for protecting against falling and flying objects shall meet the specifications contained in the American National Standards Institute (ANSI) Z89.1-1986, American National Standard for Personnel Protection - Protective Headwear for Industrial Workers - Requirements. Helmets for protecting against high-voltage electrical shock and burns shall meet the specifications contained in ANSI Z89.2-1971. Where there is a risk of injury from hair entanglements in moving parts of machinery, combustibles, or toxic contaminants, employees shall confine their hair to eliminate the hazard.

5.5.3 Hearing Protection

Hearing protection (i.e., earplugs or muffs), shall be provided and used in identified hazardous noise areas and when using equipment that produces hazardous noise. Ear plugs inserted in the ear shall be fitted, worn, and used in accordance with SOP H-10, *Hearing Conservation Program*.

5.5.4 Eye and Face Protection

Eye or face protection shall be provided for and used by employees working in locations where there is a risk of receiving eye injuries, such as punctures, abrasions, contusions, or burns as a result of contact with flying particles, hazardous substances, projections, or injurious nonionizing radiation that are inherent in the work or environment. Safety glasses shall be suitable for the exposure and meet the specifications contained in ANSI Z87.1-1989. Where there is the potential for exposure to injurious light rays, the shade of lens to use in each instance shall be selected in accordance with applicable state or federal standards. Side shield protection shall be used whenever the hazard of flying objects is angular as well as frontal. See also SOP A-7, *Personal Protective Equipment Issuance (Safety-toe Boots/Shoes and Glasses)*, Section 2.2, Safety Glasses (Plano [non-prescription] and Prescription).

5.5.5 Respiratory Protection

- All SCBAs and respirators for emergency uses will be inspected monthly by the SHSC. Records will be maintained for all inspections of emergency-use respirators.
- All personnel required to wear respirators shall receive a physical evaluation in accordance with Volume III, Medical Surveillance Program, of this manual to ensure that they have no preexisting physical or psychological conditions that may preclude them from wearing a

respirator (required under regulations outlined in 29 CFR 1910.134, *Respiratory Protection*).

- All workers using respirators must have their respirators qualitatively fit-tested at least once a year. Asbestos, arsenic, cadmium, formaldehyde, benzene, and lead workers must have unique respirator fit-tests in compliance with the standard for the chemical they are exposed to. Fit-testing ensures a proper face-to-facepiece seal [29 CFR 1910.134, 29 CFR 1926.103, *Respiratory Protection*]. The respirator head straps must be comfortable and the user should be able to perform normal and deep-breathing, side-to-side and up-and-down head movements and talking without loosening the seal. The seal will be tested by quantitative methods such as with a PortaCount. The individual will not be allowed to use the respirator until a proper seal has been obtained. The SHE Coordinator or SHSC shall maintain written fit-test records for all on-site personnel. See also SOP H-13, *Respiratory Protection Program*.
- An individual may not wear a respirator if he/she has a condition that prevents a good seal. Facial hair must not be present between the sealing surface of the respirator and the user's face (see SOP H-7, *Facial Hair Policy*). Corrective lenses that have temple bars or straps that pass between the sealing surface and the user's face may not be worn. Corrective lenses inserted inside full-facepiece respirators may be used. Contact lenses may not be used in contaminated atmospheres except with full face protection. Full dentures can be worn with respirators, but partial lower dentures may have to be removed if they interfere with a proper chin seal. It is AEE policy that all personnel working on hazardous waste/substance sites be prepared to immediately upgrade respiratory protection.

5.5.6 Body Protection

Body protection is required for employees whose work exposes parts of their body, not otherwise protected as required by other portions of this SOP, to hazardous or flying substances, or objects.

- Clothing appropriate for the work being done shall be worn. Loose sleeves, tails, ties, lapels, cuffs, or other loose clothing that can be entangled in moving machinery shall not be worn.
- The SHSC shall monitor the length of time employees wear protective clothing to prevent heat stress, fatigue, and chemical permeation of the clothing. He/she shall ensure that all procedures for PPE removal, decontamination, and donning are followed during rest breaks. Protective clothing shall be worn according to manufacturer's specifications. For example, Tyvek® coveralls shall not be tied down around the waist because the dangling, tied sleeves could get caught in rotating machinery. Instead, if only pants are desired (and have been approved by the HSP), Tyvek® pants shall be purchased specifically for that purpose. Protective clothing will be changed on a regular basis as determined by the SHSC. The duration that the clothing will be worn will be based on permeation data for the clothing material, the contaminant concentration ranges found during environmental monitoring, and working conditions (temperature, humidity, work schedules, etc.) at the site. At a minimum, protective clothing will be disposed of upon removal. To reenter a contaminated area an employee will have to put on new protective clothing.
- On-site AEE and subcontractor personnel wearing protective clothing shall inspect it while working to ensure that it is not torn, degraded, or

covered with residue. If these conditions are noted, the person shall notify the SHSC and institute proper decontamination procedures, in order to change into new protective clothing. Rips and tears should be mended at once, or the worksuit shall be immediately replaced.

- Use of protective sleeves and gloves (see below) is necessary to protect against thermal hazards posed by hot surfaces and/or hot liquids (e.g., capping compounds).
- Protective clothing saturated or impregnated with flammable liquids, corrosive substances, irritants, or oxidizing agents shall be removed and properly disposed of or shall not be worn until properly cleaned.

5.5.7 Hand Protection

Hand protection shall be required for employees whose work involves unusual or excessive exposure of hands to cuts, burns, harmful physical or chemical agents, or radioactive materials that are encountered and capable of causing injury or impairments. Gloves shall be selected by referring to MSDSs, HSPs , or consultation with a health and safety professional.

Wrist watches, rings, or other jewelry shall not be worn while working with or around machinery with moving parts in which such objects may be caught, or around electrically energized equipment.

5.5.8 Foot Protection

Appropriate foot protection that meets the requirements and specifications in ANSI Z41-1991 is required for employees who are exposed to foot injuries from electrical hazards; hot, corrosive, poisonous substances; falling objects; or crushing or penetrating actions that may cause injuries, or who are required to work in abnormally wet locations. Refer to SOP A-7, *Personal Protective Equipment Issuance (Safety-toe Boots/Shoes and Glasses)*, for the policies regarding authorization and approval for safety-toe boots.

5.6 PPE Donning/Doffing Procedure

PPE donning and doffing is particularly important when working with highly hazardous substances. Failure to follow donning and doffing procedures may result in the PPE being ineffective against contaminants. These procedures may be altered by the SHSC or SHE Coordinator if improvements can be made to the procedure and the changes are warranted in the field. Refer to SOP H-6, *Personnel Decontamination*, for personnel decontamination guidelines.

5.7 PPE Maintenance and Care

Reuse of chemical protective clothing will be permitted only if the article is nonporous, the garment has been thoroughly decontaminated, and the possibility of chemicals diffusing through the inside surface is small. Chemical-resistant boots, "splash" suits, and certain special-use gloves are examples of items that may be reused based on their condition after use. AEE personnel will also frequently use items that can be disposed of after a single use or at the end of the workday. These items include gloves, coveralls, shoe covers, and respirator cartridges/filters. Used PPE will be kept on-site for disposal in PPE drums labeled as hazardous waste. In the case of respirators, disinfecting detergents and rinses and/or wipes should be used to decontaminate and hygienically clean the facepieces after each use. After cleaning, the employee must let the respirator air dry in a clean place. After drying, the respirator shall be placed in a resealable plastic bag or clean, sealable storage container or cabinet. All respirators should be stored to protect them from dust, sunlight, heat, extreme cold, excessive moisture, and damaging chemicals.

Respirators will be checked periodically by the SHSC and inspected before each use by the wearer. A respirator maintenance program will be established to repair and/or replace respirator component parts.

Replacement parts for respiratory protective devices must be obtained from the manufacturer of the equipment. Substitution of parts from a different brand or type of respirator will not be allowed. SCBA repairs must be performed by the equipment manufacturer.

In the process of donning, each site worker and his/her buddy will examine protective clothing prior to use for imperfect seams, nonuniform coatings, tears, malfunctioning closures, pinholes, cracks, or other signs of deterioration. Any defective equipment should be returned by the SHSC for replacement after notifying procurement. The SHSC will ensure that protective equipment is periodically inspected throughout the workday, and any defective PPE repaired or replaced as needed.

The SHSC shall also ensure that all used protective clothing is disposed of properly and all new protective clothing is stored in an uncontaminated, well-ventilated area. This area must be away from sunlight, direct heat, and moisture. Clothing made of different types of materials will be separated and labeled to prevent use of the wrong material by mistake.

The SHSC will perform on-site maintenance of PPE, such as repair of hard hats or respirators that are discovered to have minor, reversible defects.

Fully encapsulated suits will be repaired by the manufacturer. Maintenance records for encapsulated suit repairs will be kept by the SHSC or SHE Coordinator.

6.0 Records

Where applicable, the following documents shall be retained as records:

- Hazard Assessment and PPE Selection form
- records listing the dates and repairs made to a respirator will be maintained for each respirator by the individual user or office SHE Coordinator (see SOP H-13, *Respiratory Protection Program*)
- all field notes, logs, records, and permits pertaining to the selection, use, maintenance, and disposal of PPE

7.0 REFERENCES

1. American National Standards Institute. Z89.1-1986 and Z89.2-1971, *American National Standard for Personnel Protection-Protective Headwear for Industrial Workers - Requirements*.
2. Cal-OSHA. 2001. 8 CCR Article 10, *Personal Safety Devices and Safeguards*.
3. Fed-OSHA. 2000. 29 CFR 1910.120, *Hazardous Waste Operations and Emergency Response.*
4. Fed-OSHA. 2000. 29 CFR 1910.134 and 29 CFR 1926.103, *Respiratory Protection*.
5. Fed-OSHA. 2000. 20 CFR 1926.101, *Hearing Protection*.
6. Fed-OSHA. 2000. 29 CFR 1910.95, *Occupational Noise Exposure*.
7. National Institute for Occupational Safety and Health (NIOSH). *Personal Protective Equipment for Hazardous Materials Incidents: A Selection Guide.* U.S. Department of Health and Human Services, Morgantown, West Virginia.
8. NIOSH/OSHA/USCG/EPA. 1985. *Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities*.
9. Schwope, A.D., Costas, P.P., Jackson, J.O., and Weitzman, D.J. 1985. *Guidelines for the Selection of Chemical-protective Clothing,* 2nd ed. Cincinnati: ACGIH, 1985.
10. U.S. Environmental Protection Agency. *Standard Operating Safety Guides*. Washington, D.C.

Excavation, Trenching, and Shoring

1.0 PURPOSE

The objective of this procedure is to establish requirements for excavation activities to ensure the safety of AMEC Earth & Environmental, Inc. (AEE) employees, subcontractor personnel, and the public who work in or around (or have access to) excavations, and to fulfill requirements of Occupational Safety and Health Administration (OSHA) 29 CFR 1926.650, .651, and .652 and state equivalents. No employee or subcontractor shall be permitted to enter excavation sites unless he/she is specifically required to do so and can enter in a safe, supervised manner. This procedure is not intended to be a specification for excavation, trenching, or shoring.

In association with this standard operating procedure (SOP), see also SOP S-2, *Control of Hazardous Energy Sources*, and S-1, *Confined Space Entry*.

2.0 SCOPE

This procedure applies to AEE field personnel, personnel subcontracted to AEE, and visitors (including clients) who may work on or visit AEE jobsites. All excavations greater than 20 feet in depth require design/approval by a Registered Professional Engineer.

3.0 DEFINITIONS

Benching - A method of protecting employees from cave-ins by cutting the sides of the excavation in an arrangement of one or more horizontal levels, usually with vertical or near-vertical walls between the steps.

Class I Perimeter Protection - Guardrails that meet the following requirements as defined by the U.S. Army Corps of Engineers (ACOE) Safety and Health Requirements Manual:

1. When Class I perimeter protection guards against personnel falling into an excavation, it shall meet the strength, height, and maximum deflection requirements for guardrails; provide fall protection equivalent to that provided by a toprail, midrail, and toeboard; and have post spacing equivalent to a standard guardrail. Refer to the SOP S-11, *Signs, Signals, and Barricades*, in this volume, and Occupational Safety and Health Administration (OSHA) 29 CFR 1926.202, *Barricades*, and 1910 Subpart D, *Walking-Working Surfaces* for specific requirements.
2. When Class I perimeter protection guards against traffic (vehicles and/or equipment) falling into an excavation it shall be designed by a Competent Person to withstand the potential forces and bending moments due to impact by traffic; if the area adjacent to the barricade will be used by both personnel and vehicles or equipment, provisions shall be made for physically separating the excavation, personnel, and traffic areas from one another.

Class II Perimeter Protection - As defined by the ACOE Safety and Health Requirements Manual, warning barricades or flagging placed not closer than 6 feet from all accessible edges of the excavation. Warning barricades or flagging must display an adequate warning at an elevation of 3 to 4 feet above ground level. Refer to SOP S-11, *Signs, Signals, and Barricades*, for information about adequate barricades and flagging.

Class III Perimeter Protection - As defined by the ACOE Safety and Health Requirements Manual, warning barricades or flagging placed a minimum of 6 inches and a maximum of 6 feet from the edge of

the excavation. Warning barricades and flagging must display an adequate warning at an elevation of 3 feet to 4 feet above ground level. Refer to SOP S-11, *Signs, Signals, and Barricades*, for information regarding adequate barricades and flagging.

Competent Person - The Competent Person has specific training in, and is knowledgeable about, soils analysis, the use of protective systems, and the requirements of 29 CFR 1926, Subpart P, *Excavations*. A person who is capable of identifying existing and potential unsanitary, hazardous, or dangerous work conditions and who has the authority to take prompt corrective measures to eliminate them. The subcontractor Competent Person must be designated by the subcontractor employer. AEE reserves the right to accept or refuse subcontractor Competent Persons.

Protective System - A method of protecting employees from cave-ins, from material that could fall or roll from an excavation face or into excavation, or from the collapse of adjacent structures. Protective systems include support systems, sloping and benching systems, shield systems, shoring, trench shields, underpinning, rock bolting, and other systems that provide the necessary protection.

Scaling - The removal of loose, overhanging, protruding, or otherwise precariously positioned material from above or along the sides of an excavation.

Sheeting - Members of a shoring system that retain the earth in position and, in turn, are supported by other members of the shoring system.

Shield - A structure that is able to withstand the forces imposed on it by a cave-in and thereby protect employees within the structure. A shield can be a permanent structure or can be portable and moved along as work progresses. Shields may be pre-manufactured or job-built. Shields used in trenches are usually referred to as "trench boxes" or "trench shields."

Shoring - A structure that supports the sides of an excavation and that is designed to prevent cave-ins. Examples are metal hydraulic, mechanical, or timber shoring systems.

Sloping - A method of protecting employees from cave-ins by excavating to form sides of an excavation that are inclined away from the excavation so as to prevent cave-ins. The angle of incline required to prevent a cave-in varies with factors such as the soil type, environmental conditions of exposure, and the magnitude and location of any loads and vibration surcharged upon the slopes.

Stable Rock - Natural, solid mineral material that can be excavated with vertical sides and remain intact while exposed. Unstable rock can be considered stable when the rock material on the side or sides of the excavation is secured against caving in or movement by rock bolts or by another protective system that has been designed by a Registered Professional Engineer.

Support System - A structural means of supporting the walls of an excavation to prevent cave-ins; includes shields, shoring, underpinning, rock bolts, etc.

Trench - An excavation made below the surface of the ground, which is narrow in relation to its length. In general the depth is greater than the width at the bottom, but the width of a trench at the bottom is not greater than 15 feet.

4.0 RESPONSIBILITIES

4.1 Corporate Safety, Health, and Environment Director

The Corporate Safety, Health, and Environment Director (Corporate SHE Director) is responsible for ensuring this procedure complies with federal and state OSHA regulations.

The Corporate SHE Director or local designee knowledgeable in the hazards and control measures in and around excavations assists the Project Manager (PM) and/or Field Manager (FM) in determining the applicability of this SOP to task performed by employees and subcontractors.

4.2 Project Manager

The Project Manager will ensure that subcontractors hired to perform trenching, excavating, and installing/removing of protective systems are knowledgeable in safe operations and adequately trained and experienced.

4.3 Field Manager

The Field Manager (FM) or their designee who works in or around excavations is responsible and accountable for adhering to and enforcing this procedure.

The FM is responsible for:

- ensuring that all employees assigned to excavation activities are instructed in the types of hazards associated with excavation operations
- ensuring adherence to safe work practices and techniques
- directing a prework safety meeting, as described in Section 5.9
- ensuring that approval from a Registered Professional Engineer is obtained when required by this procedure
- ensuring that personnel leave the excavation site if a potentially hazardous condition is recognized

4.4 Competent Person

The Site Health and Safety Coordinator (SHSC), the FM, or other qualified individual may be designated the Competent Person if qualified to do so. The Competent Person is responsible for ensuring daily that this SOP and applicable regulations are followed. He/She must also ensure that the design, construction, and maintenance of the excavation meets regulatory standards and follows this procedure.

The competent person must ensure that:

- underground installations within the work area have been located and protected from damage or displacement before digging
- where oxygen deficiency exists or a hazardous atmosphere could reasonably be expected to exist, the atmospheres in the excavation are tested before employees enter excavations greater than 4 feet in depth
- the protective system used is properly set up in the work area and is in good working condition
- the work area is safe from unauthorized vehicular and pedestrian traffic
- proper means of access and egress from the excavation are employed
- tabulated data (if applicable) are accessible at the jobsite
- the open excavation is properly covered or barricaded at the end of a work shift or day
- excavations are inspected daily for water accumulation and other recognized hazards

4.5 Employees

Employees must follow this excavation procedure and comply with applicable regulatory requirements.

4.6 Site Health and Safety Coordinator

The SHSC is responsible for implementing the Health and Safety Plan (HSP) where excavation hazards as well as other hazards are discussed for project-related fieldwork. Other responsibilities include:

- • inspecting the work site and notifying the FM of any unsafe conditions or acts
- • supervising monitoring of excavations for hazardous atmospheres where it has been deemed necessary by the HSP
- • verifying and posting locations and routes to medical facilities
- • posting emergency telephone numbers
- • suspending any operation that threatens the health or safety of team members or the public
- • conducting and documenting daily safety meetings and addressing excavation-related safety hazards
- • ensuring that proper personnel safety measures are employed; this includes a completed unexploded ordnance (UXO) clearance when excavations are performed in areas known or suspected to be contaminated with explosives, unexploded munitions, or military ordnance
- • ensuring that employees are wearing proper protective gear, as stated in the HSP

4.7 Subcontractors

Subcontractors involved with and/or providing excavation and trenching services will either accept and abide by this SOP or provide an established written program to AEE for review.

The subcontractor will provide safe and properly functioning heavy equipment operated by trained employees. The subcontracting employees must be capable of safely operating the excavation equipment and properly install excavation/trench protective systems.

The subcontractor will regularly inspect heavy and protective systems equipment to ensure safe usage and operation.

5.0 PROCEDURE

5.1 Preexcavation Requirements

Below is the sequence of steps that the FM shall follow in preparing to excavate. The FM will determine which requirements apply and ensure that they are followed.

<u>Utility Location</u>

- Before starting to excavate a site, the FM will locate identified utility installations previously marked by a Competent Person or geophysical surveyor such as sewer, telephone, fuel, electric, water lines, or any underground installations that may reasonably be expected to be encountered during the excavation work. The FM will obtain the locations of utilities from installation facility/activity personnel.
- Local utility companies shall mark the location of underground obstructions or geophysical detection methods will be used to locate underground utilities. The description of the markings as a result of the utility or geophysical survey will be documented and discussed with the FM.

- When possible, energized power lines in an area of excavation should be deenergized prior to digging in accordance with the lockout/tagout procedure. Otherwise, their exact locations shall be determined by hand-digging within 2 feet of their estimated location.
- When hand-digging (to determine exact locations of utilities), dig perpendicular (90°) to the direction of the line until it is located.
- Power line disconnects will be located before starting to excavate a site.
- The surface and subsurface of sites known or suspected to be contaminated with explosives, unexploded munitions, or military ordnance must be cleared by qualified UXO disposal personnel before excavating.

Removal of Surface Encumbrances

- All surface encumbrances (trees, poles, boulders, etc.) that create a hazard to employees shall be removed or supported, as necessary, to safeguard employees.

Designation of Competent Person

- A Competent Person shall be designated when it is anticipated or known that an excavation exceeds 4 feet. A Competent Person shall be designated for shallower excavations as conditions require. The Competent Person shall have the necessary training and knowledge as outlined in Section 4.2.

5.2 Protective systems

In all excavations with possible cave-ins, employees must be protected by sloping or benching the sides of the excavation, supporting the sides of the excavation, or placing a shield between the side of the excavation and the work area. Protective systems will be designed in accordance with 29 CFR 1926.652, *Requirements for Protective Systems*, and are required except when:

- excavations are dug entirely from stable rock
- excavations are less than 5 feet (1.52 meters [m]) deep and a Competent Person finds no indication of a potential cave-in

Protection systems include:

- sloping and benching systems
- support systems, shield systems, and other protective systems

The Competent Person may determine the necessary type of protection system (Option 1, 2, 3, or 4 in *Requirements for Protective Systems*, 29 CFR 1926.652[b] or [c]) based on the soil type and by referring to the appendices and tables in 29 CFR 1926.652, *Requirements for Protective Systems*, and shall be able to recognize when design by a Registered Professional Engineer is required.

5.2.1 Sloping

The maximum allowable slope shall be determined by a Competent Person based upon soil type and existing or potential conditions at the jobsite and in the area of the excavation. Allowable slopes will be determined by using Appendices A and B of 1926.652 or tabulated data and charts approved by a Registered Professional Engineer. Otherwise, excavations shall be sloped at an angle not steeper than 1.5:1 (horizontal to vertical).

Designs for sloping using tabulated data and charts shall be in written form and shall include all of the following:

- identification of the parameters that affect the selection of a sloping or benching system drawn from tabulated data and charts
- identification of the limits of use of the data, including the magnitude and configuration of slopes determined to be safe
- explanatory information as may be necessary to aid the user in making a correct selection of a protective system from the data

At least one copy of the tabulated data that identifies the Registered Professional Engineer who approved the data shall be maintained at the jobsite during construction of the protective system. After that time it may be stored off the jobsite with the project records.

Sloping and benching systems not utilizing Appendices A and B of 1926.652 must be designed and approved by a Registered Professional Engineer and shall be in accordance with 29 CFR 1926.652(b)(4), described in writing, and include the following:

- magnitude of the slopes that were determined to be safe for the particular project
- configurations that were determined to be safe for the particular project
- identity of the Registered Professional Engineer approving the design

Records will be maintained at the jobsite during construction. After completion, the records will be stored off the jobsite with the project records.

5.2.2 Shoring Systems

Use of portable trench boxes, sliding trench boxes, and/or shields in lieu of required sloping, benching, or supporting methods can be authorized when in accordance with one of the following requirements:

- designs are in accordance with Appendices A, C, and D of 29 CFR 1926.652
- designs are selected from and in accordance with manufacturer's tabulated data and approved by a Registered Professional Engineer
- designs are in written form and approved by a Registered Professional Engineer

Designs using tabulated data and charts shall be in written form and shall include all of the following:

- identification of the parameters that affect the selection of a support system, shield system, or other protective system drawn from tabulated data and charts
- identification of the limits of use of the data
- explanatory information as may be necessary to aid the user in making a correct selection of a protective system from the data

At least one copy of the tabulated data that identifies the Registered Professional Engineer who approved the data shall be maintained at the jobsite during construction of the protective system. After that time, it may be stored off the jobsite with the project records.

Backhoes and/or excavators used to move trench boxes and/or shields must meet the applicable requirements of ANSI and OSHA requirements.

Job-built support systems (as opposed to all-purpose manufactured support systems) must be designed and approved by a Registered Professional Engineer.

5.2.3 Materials and Equipment

Materials and equipment used for protective systems shall:

- be used and maintained in a manner that is consistent with the recommendations of the manufacturer (if any), and in a manner that will prevent employee exposure to hazards
- if damaged, be examined by a Competent Person who will evaluate its suitability for continued use (If the Competent Person determines that the material or equipment is unsuitable for safe use, then such material or equipment shall be removed from service. Such material may be returned to service if evaluated and approved by a Registered Professional Engineer.)

5.2.4 Installation and Removal of Support Systems

- Members of support systems shall be securely connected together to prevent sliding, falling, kickouts, or other predictable failure.
- Support system installation and removal shall be conducted in a manner that protects personnel from cave-ins, structural collapses, or from being struck by members of the support system.
- Individual members of support systems shall not be subjected to loads that exceed design loads.
- Before beginning temporary removal of individual members, additional precautions shall be taken to ensure the safety of employees, such as installing other structural members to carry the loads imposed on the support system.
- Removal shall begin at, and progress from, the bottom of the excavation. Members shall be released slowly so as to note any indication of possible failure of the remaining members of the structure or possible cave-in of the sides of the excavation.
- Backfilling shall progress together with the removal of support systems from excavations.

5.3 Stability of Adjacent Structures

- The stability of structures adjoining an excavation shall be evaluated by the Registered Professional Engineer and supported to protect employees from structural failure, as determined necessary by the Registered Professional Engineer.
- Excavation below the level of the base or footing of any foundation or retaining wall that could reasonably be expected to pose a hazard to employees shall not be permitted except when:
    - a support system (underpinning) is provided to ensure the safety of employees and the stability of the structure
    - the excavation is in stable rock
    - a Registered Professional Engineer has determined that the structure will be unaffected by the excavation
    - a Registered Professional Engineer has determined that such excavation will not pose a hazard to employees

- Evaluations and/or designs by the Registered Professional Engineer shall be available at the jobsite.
- Sidewalks, pavements, and appurtenant structures shall not be undermined.

5.4 Protection from Falling Loads

Excavated and/or other materials or equipment that could pose a hazard by falling or rolling into excavations shall be kept at least 2 feet (0.61 m) from the edge of excavations, or shall be retained by a device that will prevent materials or equipment from falling or rolling into excavations, or by a combination of both if necessary. Employees shall wear hard hats and safety glasses with side shields for protection.

No employee shall be permitted underneath or within arm swing of loads handled by lifting or dragging equipment. Employees shall be required to stand away from any vehicle being loaded or unloaded to avoid being struck by any spillage or falling materials. Personnel shall stand clear of operating equipment and shall be protected from potential flying objects by keeping a safe distance, and by use of shielding (vehicles, structures, etc.) and personal protective equipment (PPE) (hardhats and safety glasses with side shields).

When equipment is operated adjacent to an excavation, and the operator does not have a clear and direct view of the edge of the excavation, a warning system shall be utilized e.g., barricades, hand or mechanical signals, or stop logs.

No employee shall work on faces of benched or sloped excavations at elevations above other employees unless adequate protection (e.g., wire mesh) from falling/sliding materials is provided.

Materials such as boulders or stumps that may slide or roll into the excavation shall be removed or made safe.

5.5 Protection from Water Accumulation

Employees shall not work in excavations in which there is accumulated water, or in excavations in which water is accumulating, unless adequate precautions (e.g., special support or shield systems to protect from cave-ins, water removal to control the level of water accumulation, or use of a safety harness and lifeline) have been taken to protect employees against the hazards posed by water accumulation.

- All de-watering activities shall be monitored by a Competent Person.
- All electrical and power generating equipment must be grounded.
- If the excavation work interrupts the natural drainage of surface water (streams, run-off channels), then diversion ditches, dikes, or other suitable means shall be used to prevent surface water from entering the excavation and to provide adequate drainage of the area adjacent to the excavation.
- Excavations subject to runoff from heavy rains must be carefully inspected by a Competent Person after every rainstorm. The protection against slides and cave-ins shall be increased, if determined necessary by the Registered Professional Engineer, before employees are permitted to reenter the excavations.

5.6 Safe Access and Egress

5.6.1 Prevention of Unauthorized Entry

Protection shall be provided to prevent personnel, vehicles, and equipment from falling into excavations. Protection shall be provided according to the following hierarchy(*see definitions of Class I, Class II, and Class III perimeter protection in Section 3.0*).

A. Class I perimeter protection is required if the excavation could be easily accessible by vehicles, equipment, or members of the public.
B. Class II perimeter protection is the minimum protection required if the excavation is (1) routinely exposed to employees and (2) is either deeper than 4 feet or contains hazards (e.g., impalement hazards, hazardous substances).
C. Class III perimeter protection is the minimum protection required if the excavation does not require either Class I or Class II perimeter protection.

Excavations, temporary trenches, borings, pits, etc., shall be backfilled as soon as possible.

Temporary guardrails or barricades and flashing yellow lights, or other suitable warning lights shall be placed at all excavations that are near paths, walkways, sidewalks, driveways, or thoroughfares or where there is a possibility that vehicles or people could fall into such excavations.

Unattended open excavations shall be covered by steel traffic plates when feasible. Otherwise, barricades, lights, and caution tape shall be used to define and prevent access to the excavation.

5.6.2 Safe Entry/Exit Requirements

Workers shall not enter trenches and excavations if there is another way to perform the work (e.g. sampling or testing from backhoe buckets, hand augers, shovels, or equivalent). Attachment 1 presents procedures that must be followed for trenches of specified depths. In general, trenches less than 4 feet that are not prone to failure or collapse do not require any specific safety measures other than taking general precautions of flagging, sign posting, and avoiding and correcting unstable areas. Trenches that are between 4 feet and 5 feet in depth require provisions for access and egress and atmospheric monitoring before entry. If examination of the excavation area by a Competent Person provides no indication of a potential cave-in, then a protective system does not need to be installed for trenches between 4 and 5 feet. Trenches greater than 5 feet in depth require the same provisions as required for trenches greater than 4 feet and also require support systems before entry. Whenever there are questions about the safety of entering a trench or excavation, contact the SHSC, the Corporate SHE Director or local designee immediately.

5.6.3 Ladders and Ramps

A stairway, ladder, ramp, or other safe means of exit shall be located in trench excavations that are 4 feet (1.22 m) or more in depth so that employees need travel no more than 25 feet (7.62 m) laterally. Ladders used as accessways shall extend from the bottom of the excavation to not less than 3 feet above the surface.

Where the width of the excavation exceeds 100 feet, two or more means of exit shall be provided on each side of the excavation.

When access to excavations of 20 feet (or greater) in depth is required, ramps, stairs, or mechanical personnel hoists shall be provided.

Structural ramps used solely by employees as access or egress from excavations shall be:

- a minimum of 4 feet wide and be provided with standard guardrails
- designed by a Competent Person qualified in structural design
- constructed in accordance with the design

Ramps used for equipment access shall:

- be a minimum of 12 feet wide
- have curbs not less than 8 inches wide and 8 inches tall
- be designed by a Registered Professional Engineer

5.7 Detection of Hazardous Atmospheres

Excavations more than 4 feet deep must be tested prior to entry for oxygen deficiency or hazardous atmospheres. Excavations with underground fuel lines visible also must be monitored. Atmospheric testing shall be documented on Air Surveillance Records in accordance with the appropriate instrument operation and calibration SOP or the manufacturers instructions. Engineering controls such as blowers may be used to reduce hazardous atmospheric conditions. Air-purifying and air-supplying respirators and emergency and rescue equipment must be on hand. Excavations shall be monitored when necessary by the SHSC to ensure that the atmosphere remains safe and hazard control measures are effective. See SOP S-1, *Confined Space Entry*, for more guidelines to emergency response and excavation monitoring.

5.8 Inspections

A Competent Person shall inspect excavation sites daily. The inspection shall be made before the start of work and as needed throughout the shift. Inspections shall be made after each rainstorm or other hazard-promoting event such as vibration (e.g., earthquake, pile driving) or unanticipated traffic. A sample Excavation Checklist is provided as Attachment 2. If a hazardous condition develops, exposed employees shall be removed from the hazardous area until the situation is corrected.

Materials and equipment used for protective systems must be declared free of damage and defects. The owner/operator of heavy and mechanized equipment shall inspect his/her equipment each day before using it. Equipment deficiencies shall be corrected before placing equipment into service. A Daily Backhoe Checklist is provided as Attachment 3. It is recommended that the subcontractor owner/operator complete the Backhoe Checklist daily in order to maintain equipment in safe working condition. Checklists for other types of heavy equipment used on-site shall be designed by a Registered Professional Engineer.

5.9 Training

Individuals serving as Competent Persons shall be trained to perform the responsibilities defined in Section 4.2 and according to the requirements of 29 CFR 1926, Subpart P, *Excavations*.

The FM shall direct a prework (tailgate) safety meeting with employees working on excavation activities at the beginning of the shift. This meeting shall detail the hazards of the work to be performed, safety precautions and procedures that must be followed, and specific examples of noncompliance observed in previous shifts, if any.

6.0 REFERENCES

1. Fed-OSHA. 2000. 29 CFR 1910.146. *Permit-Required Confined Space*.
2. Fed-OSHA. 2000. 29 CFR 1926, Subpart P - *Excavations*.
3. Fed-OSHA. 2000. 29 CFR 1926.652, *Requirements for Protective Systems*
4. U.S. Army Corps of Engineers. 1996. *Safety and Health Requirements Manual*, EM 385-1-1. October.

ATTACHMENT 1

TRENCH/EXCAVATION ENTRY REQUIREMENTS

Action	**Trench/Excavation Depth (in feet)**				
	All Trenches	<4	4-5	>5	>20
General Precautions (i.e., zone delineation, flagging, sign posting, verbal instruction, utility location/demarcation/protection [avoid unstable areas], backfill or cover appropriately after completion)	√	√	√	√	√
Provide physical means of safe entry and exit (e.g., ladder[s] or ramp[s])		√	√	√	√
Competent Person present and supervising work in excavation at all times (warn of impending earth movement or other unusual developments)			√	√	√
Perform atmospheric monitoring in accordance with Air Monitoring SOP and Health and Safety Plan if personnel entry is planned or anticipated.*			√	√	√
Install adequate shoring, sloping, benching, or protective system designed by a Competent Person before entry			†	√	√
Registered Professional Engineer to design sloping, benching, or protective systems for excavations					√

* Excavations with unusual characteristics or hazards (e.g., natural gas line located within) require monitoring even if shallower depths.

† Competent Person must examine ground for potential cave-in. If potential exists, adequate shoring, sloping, benching, or other protective system must be installed before entry.

EXCAVATION CHECKLIST

(TO BE COMPLETED BY A "COMPETENT PERSON")

Site Location:		
Date:	Time:	Competent Person:
Soil Type (see attached form):		
Soil Classification:	Excavation Depth:	Excavation Width:
Type of Protective System Used:		

INDICATE FOR EACH ITEM: YES - NO - OR N/A FOR NOT APPLICABLE

All "No" items must be corrected prior to continuing work.

1.	**GENERAL INSPECTION OF JOBSITE:**	**YES**	**NO**	**N/A**
A.	Surface encumbrances removed or supported.			
B.	Employees protected from loose rock or soil that could pose a hazard by falling or rolling into the excavation.			
C.	Spoils, materials, and equipment set back at least 2 feet from the edge of the excavation.			
D.	Barriers provided at all remotely located excavations, wells, pits, shafts, etc.			
E.	Walkways and bridges over excavations 6 feet or more in depth are equipped with standard guardrails.			
F.	Warning system established and utilized when mobile equipment is operating near the edge of the excavation.			
G.	Employees prohibited from going under or near suspended loads.			
H.	Employees prohibited from working on faces of sloped or benched excavations above other employees.			
2.	**UTILITIES**	**YES**	**NO**	**N/A**
A.	Utility companies contacted and/or utilities located.			
B.	Location of utilities marked when approaching the utilities.			

C.	Underground installations protected, supported, or removed when excavation is open.			
3.	**MEANS OF ACCESS AND EGRESS**	**YES**	**NO**	**N/A**
A.	Lateral travel to means of egress less than 25 feet in excavations 4 feet or more in depth.			
B.	Ladders used in excavations secured and extended 3 feet above the edge of the trench.			
C.	Structural ramps used by employees designed by a Competent Person.			
D.	Structural ramps used for equipment designed by a Registered Professional Engineer (RPE).			
E.	Ramps constructed of materials of uniform thickness, cleated together on the bottom, equipped with no slip surface.			
F.	Employees protected from cave-ins when entering or exiting the excavation.			

INDICATE FOR EACH ITEM: YES - NO - OR N/A FOR NOT APPLICABLE

4.	**WET CONDITIONS**	**YES**	**NO**	**N/A**
A.	Precautions taken to protect employees from the accumulation of water.			
B.	Water removal equipment monitored by a Competent Person.			
C.	Surface water or runoff diverted or controlled to prevent accumulation in the excavation.			
D.	Inspections made after every rainstorm or other hazard increasing occurrence.			
5.	**HAZARDOUS ATMOSPHERE**	**YES**	**NO**	**N/A**
A.	Atmosphere within the excavation tested where there is a reasonable possibility of an oxygen deficiency, combustible or other harmful contaminant exposing employees to a hazard.			
B.	Adequate precautions taken to protect employees from exposure to an atmosphere containing less than 19.5% oxygen and/or other hazardous atmosphere.			
C.	Ventilation provided to prevent employees from exposure to an atmosphere containing flammable gas in excess of 10% of the lower explosive limit of the gas.			
D.	Testing conducted often to ensure that the atmosphere remains safe.			
E.	Emergency equipment, such as breathing apparatus, safety harness and line, and basket stretcher readily available where hazardous atmospheres could or do exist.			
F.	Safety harness and life line used and individually attended when entering bell bottom or other deep confined excavations.			
6.	**SUPPORT SYSTEMS**	**YES**	**NO**	**N/A**
A.	Materials and/or equipment for support systems selected based on soil analysis, trench depth, and expected loads.			
B.	Materials and equipment used for protective systems inspected and in good condition.			

C.	Materials and equipment not in good condition has been removed from service.			
D.	Damaged materials and equipment used for protective systems inspected by an RPE after repairs and before being placed back into service.			
E.	Protective systems installed without exposing employees to the hazards of cave-ins, collapses, or being struck by materials or equipment.			
F.	Members of support system securely fastened to prevent failure.			
G.	Support systems provided to ensure stability of adjacent structures, buildings, roadways, sidewalks, walls, etc.			
H.	Excavations below the level of the base or footing approved by an RPE.			
I.	Removal of support systems progresses from the bottom of and members are released slowly as to note any indication of possible failure.			
J.	Backfilling progresses with removal of support system.			
K.	Excavation of material to a level no greater than 2 feet below the bottom of the support system and only if the system is designed to support the loads calculated for the full depth.			
L.	Shield system placed to prevent lateral movement.			
M	Employees are prohibited from remaining in shield system during vertical movement.			
REMARKS:				
Signature: _____ Date: _____				

Fall Protection and Prevention

1.0 PURPOSE

In accordance with Occupational Safety and Health Administration (OSHA) 29 CFR 1926 Subpart M, *Fall Protection*, and 29 CFR 1926.104, *Safety Belts, Lifelines, and Lanyards*, 1926.105, *Safety Nets*, and 1926.106, *Working Over or Near Water*, the purpose of this procedure is to provide guidelines to ensure the safety of personnel working in areas where the potential exists for falls from elevated surfaces above 6 feet.

2.0 SCOPE

This procedure applies to AMEC Earth & Environmental, Inc. (AEE) personnel, personnel subcontracted to AEE, and visitors (including clients) of AEE who may work on or visit AEE job sites.

3.0 DEFINITIONS

Anchorage - Secure point of attachment for lifelines, lanyards, or deceleration device.

ANSI - American National Standards Institute.

Body Belt - A belt with means both for securing it about the waist and for attaching it to a lanyard, lifeline, or deceleration device. The body belt shall be used only to prevent falls and not as part of a fall arrest system.

Body Harness - Straps that may be secured about the employee in a manner that will distribute the fall arrest forces over at least the thighs, pelvis, waist, chest, and shoulders, and that can be attached to a lanyard, lifeline, or deceleration device.

Connector - A device used to couple (connect) parts of the fall arrest system and positioning device systems together. It may be the independent component of a system (such as a carabiner) or it may be an integral component of the system (such as a buckle or D-ring sewn into a body harness, or a snap-hook spliced or sewn to a lanyard or self-retracting lanyard).

Deceleration Device (shock-absorbing unit) - Any mechanism that dissipates a substantial amount of energy during a fall arrest, or otherwise limits the energy imposed on an employee during fall arrest. Examples include a rope grab, rip-stitch lanyard, woven lanyard, tearing or deforming lanyards, automatic self-retracting lanyards/lifelines, etc.

Fall Arrest System - A system used to arrest an employee in a fall from a working level. It consists of an anchorage, connectors, and body harness, and may include a lanyard, deceleration device, lifeline, or suitable combination of these.

Floor Hole - An opening measuring less than 12 inches but more than 1 inch in its least dimension in any floor, roof, or platform through which materials, but not persons, may fall.

Floor Opening - An opening measuring 12 inches or more in its least dimension in any floor, roof, or platform through which persons may fall.

Free Fall - The act of falling before a fall arrest system begins to apply force to arrest the fall.

Guardrail System - A barrier erected to prevent employees from falling to lower levels.

Lanyard - A flexible line of rope, wire rope, or strap that generally has a connector at each end for connecting the harness to a deceleration device, lifeline, or anchorage.

Lower Levels - Those areas or surfaces to which an employee can fall. This includes, but is not limited to, ground levels, floors, platforms, ramps, runways, excavations, pits, tanks, material, water, equipment, structures, or portions thereof.

Stanchion - An upright bar, beam, or post used as a support.

Unprotected Sides and Edges - Any side or edge of a walking/working surface that is at least 39 inches (3.25 feet) above ground surface and where there is no wall or guardrail system.

Wall Opening - An opening at least 30 inches high and 18 inches wide, in any wall or partition, through which persons may fall.

Warning Line System - A barrier erected on a roof to warn employees that they are approaching an unprotected roof side or edge, and that designates an area in which roofing work may take place without the use of guardrail, body belt, or safety net systems to protect employees in the area.

4.0 RESPONSIBILITIES

4.1 Corporate Safety, Health, and Environment Director

The Corporate Safety, Health, and Environment Director (Corporate SHE Director) is responsible for ensuring that the fall protection and prevention procedures complies with federal and state OSHA requirements. The Corporate SHE Director or local SHE designee with technical expertise assists the Project Manager (PM) and/or Field Manager (FM) in determining the applicability of the fall protection procedures to tasks performed by employees and subcontractors.

4.2 Project Manager

The PM is responsible for incorporating the requirements of this procedure into project plans, budgets, and activities. He/She is also responsible for providing the personnel, funds, and management support needed to implement the Fall Protection and Prevention procedure. The PM conducts assessments of fall protection.

4.3 Field Manager

The FM is responsible for ensuring:

- compliance with this standard operating procedures (SOP)
- personnel are trained in accordance with Section 6.0
- adequate fall arrest equipment is on-site and in good working order

4.4 Site Health and Safety Coordinator

The Site Health and Safety Coordinator (SHSC) is responsible for inspecting the work site to ensure compliance with this procedure and providing technical assistance during project planning to ensure the best method for fall protection is used. The SHSC is also responsible for ensuring that adequate training regarding fall protection is administered to employees.

4.5 Subcontractors

AEE subcontractors involved in project work where fall protection and prevention equipment/devices are warranted or required will either accept and abide by this SOP or provide an established written procedure to the AEE PM or FM for review.

If the subcontractor builds guardrails or other opening protection, the components and finished product(s) must meet OSHA requirements and those outlined in this SOP. Any fall protection equipment provided by the subcontractors for their employees or AEE employees must meet OSHA/ANSI requirements and those outlined in this SOP.

5.0 PROCEDURE

Employees on walking/working surfaces with an unprotected side or edge that is 6 feet or more above a lower level shall be protected from falling by the use of guardrail systems, safety net systems, or personal fall arrest systems.

Employees working on the edge of excavations deeper than 6 feet with sides sloped less than 1.5:1 shall be protected from falling by guardrail systems, fences, or barricades. Surfaces such as drilling derricks, if 6 feet or more above ground surface, are not exempt from this requirement.

The use of guardrail systems or other engineering controls shall be the preferred method and should be attempted first. If guardrails or other engineering controls are not feasible, a fall arrest system shall be utilized.

5.1 Guardrail Systems

A guardrail system is a barrier erected to prevent employees from falling to lower levels. Guardrail systems, or other engineering controls, are the preferred form of fall protection. For work taking place at 4 feet, a guardrail with a midrail is required to comply with 29 CFR 1910.23, *Guarding Floor and Wall Openings and Holes*. Work that is performed at 6 feet (or above) requires a guardrail to comply with 29 CFR 1926.501, *Duty to Have Fall Protection*. Work at 25 feet over water requires fall protection to comply with 29 CFR 1926.105, *Safety Nets*.

A guardrail shall consist of the following:

- a top rail, 42 inches (3.5 feet) plus or minus 3 inches above the surface
- a midrail, halfway between the top rail and the surface, or a screen extending from the top rail to the surface

Guardrail systems shall be capable of withstanding, without failure, a force of at least 200 pounds applied within 2 inches of the top edge. When applied in a downward direction, the top edge shall not deflect to a height less than 39 inches.

For wood railings, the top rails and posts shall be at least 2-inch by 4-inch lumber, with posts spaced not more than 8 feet on center. The midrail shall be at least 1-inch by 6-inch lumber.

For pipe railings, the posts, top rails, and midrails shall be at least 1.5 inches in diameter (schedule 40 pipe) with posts spaced not more that 8 feet apart on centers.

Toeboards or screens shall be installed when there is a potential for material to fall onto personnel on a lower level. Toeboards shall be a minimum of 3.5 inches high and installed with a maximum clearance of 1/4 inch above the surface.

5.2 Fall Arrest Systems

Fall arrest systems are required when the use of guardrails or other engineering controls is not feasible. Fall arrest systems consist of an anchorage, connectors, and body harness, and may include a lanyard, deceleration device, lifeline, or a suitable combination of these. Examples of fall protection/arrest system components are shown in Attachment 1. Fall arrest system examples are shown in Attachment 2. Procedures for fall protection are as follows:

- All fall arrest equipment shall be appropriate for the task; shall meet the requirements of 29 CFR 1926.502(d), .104, .105, .106; and shall be ANSI-approved.
- All fall arrest equipment shall be inspected before each use. Equipment that shows evidence of damage must be immediately tagged "Do Not Use." Some fall protection equipment inspection points are provided in Attachment 3.
- All fall arrest equipment used in a fall must be immediately turned over to the SHSC and not reused.
- Body belts may not be used in fall arrest systems.
- Snap-hooks shall be a locking type designed to prevent accidental disengagement.
- Double lanyard systems shall be required if disengagement of a lanyard is required for employee movement. At least one lanyard shall remain connected at all times during movement.

5.3 Warning Line Systems

Warning line systems shall be utilized to inform personnel they are nearing an unprotected edge. They shall be erected not less than 6 feet from the unprotected edge and consist of ropes, wires, or chains, and supporting stanchions erected as follows:

- The warning line system shall be flagged at not more than 6-foot intervals with high-visibility material or a high-visibility tape or ribbon at least 2 1/2 inches wide.
- The warning line system shall be suspended in such a way that its lowest point is no less than 34 inches and its highest point no more than 39 inches.
- The stanchions, with line attached, shall be capable of resisting, without tipping over, a force of at least 16 pounds applied horizontally 30 inches above the surface.
- The warning line system shall have a minimum tensile strength of 500 pounds.
- The warning line system shall be secured to the stanchions in such a way that pulling on one section will not result in slack being pulled from other sections before the stanchion tips over.

5.4 Floor, Roof, and Wall Openings

All floor openings shall be guarded by a standard guardrail or cover. Covering shall be secured in place to prevent accidental removal or displacement and shall be labeled "Caution: Opening - Do Not Remove."

Ladderway floor openings or platforms shall be guarded by standard railings with standard toeboards on all exposed sides, except at the entrance to an opening, with the passage through the railing either a swinging gate or offset so that a person cannot walk directly into the opening.

Whenever there is a danger of falling through a skylight opening, the skylight shall be guarded by a fixed standard guardrail or cover capable of sustaining the weight of a 200-pound person.

Wall openings from which there is a drop of more than 4 feet to the surface below, and whose bottom opening is less than 3 feet above the upper working surface that leads to the wall opening, shall be guarded with a standard guardrail.

6.0 TRAINING

Employees utilizing fall protection shall be trained in the following areas:

- the nature of fall hazards in the work area
- correct procedures for erecting, maintaining, disassembling, and inspecting the fall protection systems to be used
- use and operation of guardrail systems, fall arrest systems, warning line systems, and other protection to be used
- correct procedures for handling and storing equipment and materials and erecting protection from overhead hazards (e.g., falling objects from above)

Employees shall be retrained when:

- changes in the workplace render previous training obsolete
- changes in the types of fall protection systems or equipment to be used render previous training obsolete
- their behavior on-site indicates that they have not retained the initial training or did not comprehend the importance of it

7.0 RECORDS

7.1 Inspection and Maintenance

Fall protection equipment shall be inspected for damage and deterioration prior to each use. Attachment 3 indicates inspection items of fall protection systems. Defective components shall be removed from service and submitted to the SHSC for repair or replacement.

When used, the SHSC shall inspect safety nets weekly for wear, damage, and other deterioration. Defective components shall be removed from service. Defective nets shall not be used.

Inspection and maintenance will be documented on the Fall Protection System Inspection and Maintenance Record (Attachment 4).

7.2 Training

A record of attendance at training sessions shall be maintained in the employee records. The record shall contain the name, social security number, employer's name, date of training, and the signature of the person who conducted the training. Training records will be maintained by the SHSC as part of the project and company records.

8.0 References

1. Fed-OSHA. 2000. 29 CFR 1910.23, *Guarding Floor and Wall Openings and Holes*.
2. Fed-OSHA. 2000. 29 CFR 1926 Subpart M, *Fall Protection*.
3. Fed-OSHA. 2000. 29 CFR 1926.104, *Safety Belts, Lifelines, and Lanyards*.
4. Fed-OSHA. 2000. 29 CFR 1926.105, *Safety Nets*.
5. Fed-OSHA. 2000. 29 CFR 1926.106, *Working Over or Near Water*.

6. Fed-OSHA. 2000. 29 CFR 1926. 501, *Duty to Have Fall Protection*.
7. Lab Safety Supply. 2001. Personal and Environmental Safety - 2001 General Catalog.
8. National Safety Council. 1992. *Accident Prevention Manual for Business & Industry: Engineering & Technology*. 10th ed.

Fire Prevention for Field Work

1.0 PURPOSE

The purpose of this procedure is to inform personnel of the requirements and methods for addressing fire and explosion hazards associated with field work and to summarize the standard protocol for fire prevention. This information describes standard industry practices for the safe handling and storage of flammable and combustible liquids during site investigations. Additional measures to address specific cases must be devised jointly by those directly responsible and a representative from Health and Safety Management. Procedures to follow in the event of a fire are outlined in the AMEC Earth & Environmental, Inc. (AEE) *Emergency Action Plan* in Volume V, Emergency Preparedness Program, of the Corporate Safety, Health and Environment Manual and in SOP ER-2, *Emergency Action Plan for Field Work*.

2.0 SCOPE

This procedure applies to all AEE personnel, personnel subcontracted to AEE, and visitors (including clients) who may work on or visit AEE jobsites.

3.0 DEFINITIONS

Class A Fire - A fire involving ordinary combustibles, such as trash, wood, or paper.

Class B Fire - A fire involving flammable or combustible liquids, flammable gases, greases and similar materials, and some rubber and plastic materials.

Class C Fire - A fire involving electrical equipment or wiring.

Bonding - The linking of two containers by an electrical connection, usually a copper wire with clamps or "alligator" clips.

Combustible Liquid - A liquid having a flash point at or above 100 degrees Fahrenheit (°F) and below 200°F, as defined by the Occupational Safety and Health Administration (OSHA).

Extinguisher Classification - The letter classification given an extinguisher to designate the class(es) of fire on which it will be effective (A, B, C, or D).

Extinguisher Rating - The numerical rating given to an extinguisher that indicates the extinguishing potential of the unit.

Flammable Liquid - A liquid having a flash point below 100°F and having a vapor pressure less than 40 psi (absolute) at 100°F, as defined by OSHA.

- Class 1 flammable liquids have flash points <100°F (e.g., gasoline and alcohol).
- Class 2 flammable liquids have flash points >100°F and <140°F (e.g., kerosene, diesel, and some solvents).
- Class 3 flammable liquids have flash points >140°F and <200°F (e.g., fuel, transformer and lube oil).

Grounding - Eliminates the difference in electrical potential between a container or equipment and the earth. Grounding wires or straps must be connected to known grounds such as water pipes or grounded

metal building framework. Objects that must be grounded include generators, pumps, fuel tanks, and fuel cans.

4.0 RESPONSIBILITIES

It is the responsibility of the Project Manager (PM), Field Manager (FM), Corporate Safety, Health, and Environment Director (Corporate SHE Director), and Site Health and Safety Coordinator (SHSC) to ensure that this procedure is followed by all field personnel.

All field personnel are responsible for implementing this procedure during all phases of AEE field operations.

4.1 Corporate Safety, Health, and Environment Director

It is the responsibility of the Corporate SHE Director to ensure that this procedure complies with OSHA regulations.

4.2 Project Manager

The PM is responsible for incorporating the requirements of this procedure into project plans, budgets, and activities, including appropriate storage vessels and fire extinguishers.

4.3 Field Manager

It is the responsibility of the FM to ensure that all personnel are aware of the fire prevention procedures and have a plan of action that lists all precautions and preparations that must be made in the event of an on-site fire.

The FM shall notify all personnel and visitors when a fire occurs on-site. The FM is responsible for overseeing all fire emergency activities and shall ensure that all personnel evacuate the site in the event of an uncontrollable fire (i.e., not controllable with portable fire extinguishers). The FM is also responsible for investigating the incident, ensuring that the incident is properly and accurately recorded, and ensuring that records of the incident are maintained.

4.4 Site Health and Safety Coordinator

The SHSC is responsible for implementing and enforcing this procedure, as directed by the Corporate SHE Director during project operations and activities. The SHSC will coordinate with the FM to ensure that all preventive measures are followed. In the event of an on-site fire, the SHSC will immediately attend to injured personnel and work jointly with the FM in assessing the situation.

Once a fire is deemed uncontrollable, the SHSC will notify the Corporate SHE Director of the situation.

4.5 Subcontractors

All personnel subcontracted to AEE and working on a field project must follow this procedure and may also be required to complete forms and make reports required by the subcontracting company.

5.0 PROCEDURE

The risk of fire and explosion can be minimized by anticipating, recognizing, evaluating, and controlling the hazards associated with flammable and combustible liquids. This procedure details the steps required

to prevent fires and explosions. These steps include using specific tools or equipment, such as a combustible gas meter and nonsparking tools, and following standard fire prevention practices. It is a violation of company policy to be aware of and yet fail to correct potentially hazardous situations. Furthermore, no employee can knowingly allow a hazardous condition to exist that could cause injury. Good housekeeping and a sense of responsibility by everyone performing their fire prevention duties will minimize fire and explosion hazards. The field crew and the PM/FM must work together to ensure the safety of personnel.

5.1 Guidelines

5.1.1 Guidelines for the SHSC

- The SHSC will consult the site-specific Health and Safety Plan (HSP) to determine the location and type of extinguisher to be used. The location of the fire extinguisher(s) on-site may change over the course of the project duration and site activities.
- The location of fire extinguishers cannot be changed without the approval of the SHSC. If a fire extinguisher is moved to a different location, the SHSC will notify all site personnel at that time.
- The SHSC or designee will visually inspect extinguishers, and initial and date the inspection tag on each extinguisher at least once per month. At least once per year, each extinguisher shall be weighed, pressure tested, and serviced as necessary by a certified fire service company.

5.1.2 Guidelines for Field Manager

The FM is responsible for the following:

- Identify the most likely sources of fire in the project area, guided by the knowledge of the "fuel" and ignition sources that characterize the operations.
- Establish rules and precautions for likely fire scenarios.
- Emergency response training is required by law for all workers who handle hazardous waste. the training includes fire suppression, protective equipment, evacuation, and contingency planning. It is the FM's responsibility to see that site staff are properly trained.
- Enforce the rules and precautions to employees and contractors on-site. Make sure each site worker knows his/her responsibilities related to specific fire or explosive hazards.
- Check access to fire extinguishers at the project site. Make sure they can be easily reached and that site workers know where they are located.
- Contact a local fire service company as soon as possible anytime an extinguisher is discharged, whether partially or fully. The fire service company will recharge and service (or replace) the extinguisher.

5.1.3 Guidelines for All Site Staff

- Smoking is NOT allowed in areas where a fire hazard may exist.
- Report all fires, no matter how small, to the SHSC or FM.
- Be familiar with the location of all fire extinguishers. Extinguishers are to be used only by those who have been trained in their usage, and only on incipient, manageable fires (less than half the size of the observer). If the

fire is too large or not manageable in your estimation, contact the local fire department.
- Anytime a fire extinguisher is used, no matter how little, notify the SHSC or FM. Any used extinguisher must be serviced before it is available again for usage.
- Never remove extinguishers from their location except to combat fires. If you move an extinguisher, notify the SHSC or FM.

5.2 On-site Fire Hazards

Fire and explosion at field sites are usually caused by moving drums, accidentally mixing incompatible chemicals, a generator malfunctioning, or introducing an ignition source into an explosive or flammable environment. Ignition sources may be as obvious as a combustion engine or an open flame or as subtle as metal-to-metal sparking or static electricity.

Static electricity is generated by the contact and separation of dissimilar materials. It can accumulate under many circumstances:

- during splash filling
- while a liquid flows through a pipe or from an orifice into a tank
- by moving pulley belts or vehicle tires
- by mixing and agitating materials

The accumulation of static electricity in two charged bodies can generate a spark unless they are joined by a good electrical conductive path. Bonding and grounding provides an electrical conductive path. Further discussion on bonding and grounding is provided in Section 5.3.4.

5.3 Prevention

5.3.1 General Considerations

On hazardous waste site and industrial locations the following measures will be followed:

- Approved receptacles shall be used for holding rubbish, waste materials, paper, and other combustibles. Accumulation should be removed and disposed of in accordance with local ordinances.
- Brush, leaves, grass, and weeds shall be removed from around buildings, switch structures, fences, and poles when they present a fire hazard. Burning of any materials shall be done only with proper regard to surrounding conditions, and in accordance with regulations or public authorities, including securing necessary permits. Open fires shall not be left unattended or abandoned until thoroughly extinguished. Adequate fire extinguishing equipment must be readily available.
- Rags, waste, and packing materials such as straw, burlap, paper, and excelsior, except those packed in unbroken bales, are a fire hazard. When stored in or adjacent to a building, such material must be kept in covered metal containers and removed from unit operating areas daily. When not in actual use, rags and waste that have been used for cleaning machinery or equipment, or for painting operations, shall be kept in Underwriters Laboratories, Inc. (UL)-approved metal waste cans with self-closing covers and away from any source of ignition.
- All sources of ignition shall be prohibited within 50 feet of a potential fire hazard, including areas where flammable, combustible, or oxidizing

materials are stored. Signs indicating **NO SMOKING OR OPEN FLAMES** shall be conspicuously and legibly posted in the area.
- Smoking is prohibited on hazardous waste sites except in designated areas.
- Nonsparking, explosion-proof or intrinsically safe equipment will be used when necessary.
- All personnel will follow safe standard practices while performing tasks that might result in the release of flammable or explosive atmospheres.
- Personnel shall use equipment such as combustible gas or oxygen meters to detect flammable/explosive environments. Equipment shall be calibrated to a gas with a comparable lower explosive limit (LEL).
- Fire lanes that provide access to all areas shall be established and maintained free of obstruction.

5.3.2 Flammable and Combustible Liquids

Flammable and combustible liquids such as gasoline or diesel fuel may be brought into a work site by either of two methods: (1) in bulk containers, or (2) in UL-approved safety containers.

Unless otherwise specified, the term "flammable liquids" refers to all classes of flammable and combustible liquids. Attachment 1 provides a table of storage instructions for flammable and combustible liquids. Attachment 2 provides a table of handling instructions for flammable and combustible liquids. Standard practices for the safe handling, transfer, and storage of these liquids include the following:

- Solvents and paint removers shall not be used in rooms, generator pits, tanks, or other enclosed areas unless adequate ventilation is provided, and shall never be used in locations where electric sparks may occur or where unguarded electric lamps are used. Only hazardous materials approved by the FM or SHSC may be used.
- If flammable or combustible liquids are brought to the site in bulk containers, the container must be securely mounted on the transporting vehicle. Fuel may <u>not</u> be transported in unsecured 55-gallon drums.
- Bulk fuel delivery trucks must have a grounding wire, which is to be used whenever equipment is being refueled.
- Bulk flammable/combustible tanks must be stored at least 100 feet from the drill rig or other equipment with internal combustion engines.
- The fuel storage area must be cordoned off, protected from the elements, and posted with a "No Smoking" sign. Containers of hydraulic oil, motor oil, and other combustible materials needed at a work site should also be stored at this location.
- The exhaust of equipment powered by internal combustion engines will be located well away from flammables and combustibles.
- Appropriate spill containment and response equipment shall be located in, or easily accessible to, areas where flammables are used or stored, including refueling.
- At least one portable ABC- or BC-rated (as appropriate) fire extinguisher shall be located in all service and refueling areas, not less than 25 nor more than 75 feet from any outside flammable liquid storage area; within 75 feet of each pump and dispensing unit; and/or within any vehicle loading, transporting, or dispensing flammable liquids.
- All portable fire extinguishers must be inspected monthly and maintenance performed annually. Monthly inspections and annual maintenance records (i.e., tags) must be attached to each fire extinguisher.

- AEE personnel assigned to work on a field project site must have documented training in using a fire extinguisher. This training shall be refreshed annually.
- Flammable liquids shall be kept in UL-approved, tightly capped and tightly closed containers when not in use, and shall be stored out of direct sunlight.
- UL-listed, self-closing flammable cans with spark arrestors must be used for storing flammable liquids that are in immediate use.
- All containers must be labeled clearly to show contents and hazard warnings in accordance with the OSHA *Hazard Communication* standard, 29 CFR 1910.1200.
- Drums containing Class 1 liquids must be stored in a vertical position and must be equipped with a dispensing pump. These liquids (e.g., gasoline) shall not be dispensed by gravity from tanks or drums. Drums and pumps shall be electrically grounded and a bond installed to metal containers being filled with Class 1 liquids. Class 1 liquids that are in immediate use must be stored in UL-approved, self-closing flammable cans. When not in use, flammable cans should be stored in a UL-approved flammable cabinet.
- Class 2 liquids (e.g., diesel fuel) may be stored in a vertical or horizontal position and may be dispensed by gravity from tanks and drums, provided they are equipped with a UL-listed, self-closing valve. Class 2 liquids must also be contained within a UL-approved flammable can and, when not in use, stored in a flammable cabinet.
- Class 3 liquids may not be dispensed by gravity from tanks and drums inside a building without local fire department approval. All combustible liquid storage must be in compliance with local code and ordinance requirements.
- The mouths of all metallic containers of 5 gallons or less must be kept in metallic contact during the transfer of flammable liquids.
- Drums and pumps must be electrically grounded and a bond installed to metal containers of flammables in excess of 5 gallons.
- Flammable and combustible liquids shall not be stored in areas used for exits, stairways, or safe passage of people.
- Dispensing units must be protected against damage from collisions.
- Dispensing nozzles and devices for flammable liquids shall be UL-approved.
- Flammable and combustible liquids must not be used, dispensed, or otherwise handled within 50 feet of an open flame or other ignition source.
- Equipment using flammable liquid fuels must be shut down during refueling, servicing, or maintenance.
- Generators, lanterns, and similar equipment shall not be filled while hot; these devices shall be filled only in well-ventilated areas that are free of open flames and shall not be filled in storage areas or buildings.
- Workers shall guard carefully against any part of their clothing becoming contaminated with flammable or combustible fluids. They shall not be allowed to continue work if their clothing becomes contaminated and must remove or wet down the clothing as soon as possible.
- Flashlights and electric lanterns used during the handling of flammable liquids must be UL-approved or otherwise certified for use in flammable/explosive environments.
- Flammable liquids and greases kept in buildings used for storage or processing must be stored in a metal cabinet that meets National Fire

Protection Association (NFPA) 30 standards, if the total quantity of liquids and greases exceeds 25 gallons.

- Ventilation adequate to prevent the accumulation of flammable vapors to hazardous levels shall be provided in all areas where flammable and combustible liquids are handled or used.
- Unopened containers of flammable and combustible liquids, such as isopropyl alcohol, shall be kept in a well-ventilated location, free of smoke, sparks, flame, excessive heat, or direct rays of the sun.
- A Material Safety Data Sheet (MSDS) must be kept on-site (with the HSP) for all chemicals/fuels used and brought on-site.
- All containers shall be plainly labeled to show the contents and hazard warning.
- Gasoline must not be used for cleaning or decontaminating purposes.
- All areas where Class 1 and Class 2 liquids are being used shall be adequately posted with approved "No Smoking" signs.
- Flammable liquids shall be stored in accordance with all local code and ordinance requirements.
- Paint, varnish, thinner, and similar materials should be stored in a building or structure assigned for this purpose. Such storage areas shall be labeled with conspicuous lettering - FLAMMABLE - KEEP FIRE AWAY.
- When not in use, partly used cans of paint, etc. shall always be kept to a minimum and tightly covered. Such cans shall be stored in a metal paint locker or in buildings or rooms specially constructed for that purpose. Paint lockers shall be in compliance with NFPA, OSHA, and Uniform Fire Code (UFC) guidelines or requirements. Shelving in such paint storage buildings or rooms shall be made of steel. Where separate storage buildings are used, they shall not be less than 25 feet from any other structures.

Standard refueling practices include the following:

- Gasoline or diesel motors are never to be refueled while in operation or while hot enough to ignite highly volatile vapors.
- Turn off all electrical switches and the engine before refueling.
- Never completely fill portable containers (allow for expansion).
- Fuel nozzle must always stay in contact with the opening of the receiving tank to prevent static spark.
- Bulk containers involved in fuel transfers shall be grounded.
- Do not spill fuel on hot surfaces. Clean any spillage before starting engine.
- Never use wool or metallic cloth due to the possibility of static spark.

5.3.3 Compressed Flammable and Oxidizing Gases

Locations where compressed flammable and oxidizing gas cylinders are stored shall be out of bounds to unauthorized personnel and shall be conspicuously posted with "No Smoking" signs. This area shall be kept free of sparks or flames from any source at all times. Gas cylinders are designed to withstand temperatures within the range of 32°F to 120°F without exceeding the fracture disc rating. The heating effect of the sun's rays should be considered in arranging for the storage of gas containers. Cylinders shall be braced upright to prevent toppling and stored away from elevators or walkways, or where heavy moving objects may strike or fall on them. Cylinders should be protected from tampering by unauthorized individuals. Storage should be planned so that cylinders may be used in the order in which they are received from the supplier. Empty and full cylinders should be labeled as such and stored separately.

Cylinders should not be exposed to continuous dampness and should not be stored near salt or other corrosive chemicals, vapors, or fumes. Cylinders shall be protected from extremes of weather and from the ground to prevent rusting. Valves shall be closed on all empty or not-in-use cylinders.

Except when cylinders are in use or connected for use, valve protection caps, where appropriate, shall always be in place, hand-tight. Unless cylinders are secured on a special truck or rack, regulators shall be removed and valve protection caps installed before cylinders are moved. Attachment 1 provides storage information for compressed gases. Attachment 2 provides handling information for compressed gases.

Oxygen

Only the fittings supplied with oxygen cylinders shall be used with oxygen cylinders. The use of oil or oily rags to clean or wipe oxygen gauges, pressure regulators, or valves is dangerous and therefore prohibited. Fittings, pipe, tubing, and devices such as valves, pressure regulators, or gauges must not be removed from cylinders containing other gases or liquids, particularly nitrogen, and then installed on oxygen cylinders or oxygen systems. Nitrogen gas is dried by using oil, and traces of oil may be deposited on fittings attached to nitrogen cylinders. If these fittings are then installed on oxygen cylinders, the traces of oil may be ignited by oxygen under high pressure and result in a destructive explosion.

All oxygen cylinders shall be equipped with proper pressure regulating devices before use.

Oxygen shall never be used for purging pipe lines, ventilating work areas, or dusting clothing.

Hydrogen

As hydrogen gas is lighter than air, rooms where it is stored should have ventilation outlets in the ceiling. Hydrogen cylinders must be equipped with pressure relief devices. They shall be stored in assigned locations that are well ventilated, dry, and separated from combustible materials. Hydrogen must be separated from oxidizing gases by at least 20 feet. Conspicuous signs must be posted in the area forbidding smoking, open lights, or other open flames.

Acetylene

Only approved and properly maintained acetylene cylinders shall be used. In addition to the shut-off and regulatory valves at the tank, there shall be a shut-off valve on the handle for test purposes. Tanks, hoses, and regulators shall be inspected and tested for leaks with a soap solution prior to each day's use and, if found to be defective, shall not be used.

Keep cylinders in an upright position at all times. When being transported or used, they shall be properly secured to prevent toppling.

NOTE: Acetylene cylinders contain acetone liquid that may damage the diaphragm of the regulator if the tank is used in other than the upright position.

Cylinder valves are to be turned on and off only with the special wrench or key provided in order to prevent damage to the valve. Never light a torch with an open flame; use only a flint or spark lighter. After use, shut gas off at both the main supply valve on the bottle and the regulator. Bleed gas from hose by opening shut-off valve at torch handle.

5.3.4 Bonding and Grounding

The making and breaking of contact between materials builds up differences of electrical potential and generates static electricity. When the difference of potential is sufficient to bridge the dielectric gap between the materials, sparking discharges occur.

The static discharge phenomenon can be a fire or explosion hazard in the handling of flammable or combustible liquids.

Anti-static additives may be added to some liquids to increase the conductivity of the liquid, preventing the accumulation of static potential, and thereby preventing static sparks.

Bonding to prevent differences in potential between hoses or pipes and tanks is required.

NOTE: Grounding the fill pipe or filling through a grounding screen does NOT prevent static discharge inside the tank.

Bonding and grounding prevents static electricity from causing a spark during the transfer of flammable liquid. However, for it to be effective, both containers must be metal and at least one container must be grounded. It is important that clamps or clips make a good metal-to-metal contact and are not blocked by a nonconductive material, such as paint. Inexpensive bonding and grounding "kits" are available from Lab Safety and other safety vendors.

5.3.5 Purging

As practicable, vessels to be filled with flammable or combustible liquids should be purged with inert gas such as dry nitrogen or carbon dioxide to remove oxygen (fuel tanks in some cases may be purged with natural gas), and the purging agent should then be displaced by the liquid, or the vessels should be "vacuum filled." This is especially important when filling from the top, or filling in any other manner that results in the splashing of liquid. Tanks having floating roofs are relatively free from fire and explosion via static spark if the vapor space above the floating roof is well ventilated. Such tanks, when empty, should have flammable or combustible liquids injected at a low flow rate until the roof is afloat.

A gasoline tank that has been completely emptied for repair or some other purpose must be purged with inert gas to prevent an explosion.

5.3.6 Hot Work

A Hot Work Permit (see SOP S-8, *Hot Work Permits*) will be completed and approved before beginning any activity (such as welding, grinding, or chipping) that could produce sparks, flames, or other sources of ignition.

- When in operation, welding torches must be at a safe distance from flammable solids, fluids, or gases, and where fire might occur, special care must be taken to control sparks. Torches and hoses shall be inspected frequently to be sure that all working parts are in good operating condition and to ensure that there are no leaks.
- When welding in areas with wooden floors with open cracks or welding on open grating, the floor areas or grating in the immediate vicinity of the welding operation shall be covered with metal plates, noncombustible pads, or wet canvas covered with sand before welding is commenced. Use metal spark screens when necessary. Adequate precautions shall be taken to prevent molten metal sparks from dropping through the cracks or grating into inaccessible locations and starting fires.

- When welding, cutting, or heating, suitable fire extinguishing equipment shall be readily available in the work area.

5.3.7 Electrical Wiring and Equipment

The fundamental causes of electrical fires are arcs, overheating due to overloading, or improper installation of circuits. Fuses and circuit breakers are the safety valves of electrical systems and must be properly installed and maintained at all times. Bypassing of breakers and fuses is prohibited. All electrical wiring shall be installed and maintained in accordance with local ordinances and standards.

Electrical equipment shall be connected only to those circuits designated to accommodate them. Flexible cords shall not be spliced and shall be replaced if worn or frayed. Where extension cords are used, they shall be of the proper conductor size for which they are used.

5.3.8 Stoves, Heaters, and Coffee Pots

Space-heating stoves and heaters shall be of an approved type, and installed and maintained with suitable clearance above, on each side, and in the front of the appliance. Care must be exercised when filling reservoirs of oil or kerosene-fired portable heaters. Whenever stoves and heaters are used, adequate ventilation must be provided.

Electrical coffee pots or tea kettles are permitted only if a routine procedure is established to ensure that the appliances are shut off at the close of business. Employees working late or on weekends are responsible for checking to see that all appliances are off. If personal coffee pots or electrical tea kettles are housed in an area other than a kitchen, the pot/kettle must rest on a heat resistant tile or base.

5.4 Emergencies

The following is a list of steps that must be taken once a fire or explosion is detected:

- The person who detects the fire must sound the emergency alarm to alert all on-site personnel.
- The FM will call 9-1-1 or summon the local fire department, advising them of the location, nature, and identification of the fire, and informing them of potential site hazards.
- If the fire is less than half the size of the observer, the fire can be extinguished using a hand-held portable fire extinguisher.
- In the event of an uncontrollable fire, the FM will evacuate the site.
- After evaluating the immediate situation and downwind direction, all personnel will be evacuated in the upwind direction to a predetermined assembly area. All personnel will be counted and the fire department notified of any missing persons.
- Notify the PM who will notify the client.

With the approval of the SHSC or FM, and only if it can be done safely, site personnel may do the following:

- Trained personnel may respond to localized, controllable (less than half the size of the observer) fires with the appropriate portable fire extinguishers that are available on-site.
- Remove or isolate flammable or other hazardous materials that may contribute to the fire.
- Begin containment and recovery of spilled materials, as appropriate.

6.0 Training Requirements

OSHA regulations (29 CFR 1910.157, *Portable Fire Extinguishers*) require that an employer who provides portable fire extinguishers for employees to use in the workplace must also provide training to familiarize employees with the general principles of fire extinguisher use and the hazards involved in incipient stage fire fighting.

Fire extinguisher training at AEE is offered at least annually to all field employees. Supervisors are strongly encouraged to see that their staff attends one of the training sessions.

7.0 RECORDS

An Incident Report (Attachment 3) must be completed by the SHSC and FM if there is an on-site fire. The completed Incident Report must be submitted to the Corporate SHE Director. In the event of an injury/illness associated with a fire, the Supervisor's Report of an Injury and Illness and a First Aid Incident Report must also be completed and submitted. Fire extinguisher training records shall be retained by the SHE Coordinator at the home office location for each affected employee.

Where applicable, the following documents shall be retained as records:

- Hot Work Permits
- All field notes, records, and logs that apply to hot work
- Fire extinguisher inspection and maintenance records or tags
- Incident Report

8.0 REFERENCES

1. Fed-OSHA. 2000. 29 CFR 1910.38, *Employee Emergency Plans and Fire Prevention Plans*.
2. Fed-OSHA. 2000. 29 CFR 1910.157, *Portable Fire Extinguishers*.
3. U.S. Army Corps of Engineers. 1996. Safety and Health Requirements Manual. October.
4. U.S. Department of Health and Human Services. 1983. Comprehensive Safety Recommendations for Land-Based Oil and Gas Well Drilling. September.

OSHA Compliance Visit Guidance for Field Projects

1.0 PURPOSE

The Occupational Safety and Health Administration (OSHA) is authorized under the OSH Act to conduct workplace inspections. Every establishment covered by the Act is subject to inspection by OSHA compliance safety and health officers (Compliance Officers). This procedure outlines the actions to be taken in the event of a compliance visit.

2.0 SCOPE

This procedure applies to all AMEC Earth & Environmental, Inc. (AEE) personnel, personnel subcontracted to AEE, and visitors (including clients) who may work on or visit AEE jobsites. It is to be used in conjunction with any existing facility procedures where work is to be performed.

3.0 DEFINITIONS

Area Director - Employee or officer regularly or temporarily in charge of an OSHA Area Office, U.S. Department of Labor, or any other person(s) authorized to act for such employee or officer.

Compliance Safety and Health Officer (Compliance Officer) - A person authorized by the OSHA, U.S. Department of Labor to conduct inspections.

Inspection - Any inspection of an establishment; project site; or other area, workplace, or environment where work is performed by an AEE regular or subcontracted employee. Includes any inspection conducted pursuant to a complaint, any reinspection, follow-up inspection, or accident investigation.

4.0 RESPONSIBILITIES

The Corporate Safety, Health, and Environment Director (Corporate SHE Director); Project Manager (PM); Field Manager (FM); Unit Manager, Safety, Health and Environment Coordinator (SHE Coordinator), and Site Health and Safety Coordinator (SHSC) are responsible for ensuring compliance of this procedure by all field personnel.

4.1 Corporate SHE Director

It is the responsibility of the Corporate SHE Director to ensure that this procedure complies with federal and state OSHA regulations, and other applicable guidelines. The Corporate SHE Director will assist the SHSC and FM with clarification of AEE policies, procedures, and programs. The Corporate SHE Director will give direction during an inspection and if any citations are received.

4.2 UNIT Manager

The Unit Manager shall be knowledgeable of the content of this standard operating procedure (SOP) and provide assistance to his/her SHE Coordinators in the event of an OSHA visit.

4.3 Project Manager/Field Manager

The FM is responsible for locating the SHSC who will be the authorized AEE representative, contacting the Corporate SHE Director and the Project Manager upon arrival of the OSHA Compliance Officer,

answering all questions asked, and taking notes of the visit. The PM/FM assists the SHSC in the preparation of the Report of an OSHA Inspection form (Attachment 1).

4.4 Site Health and Safety Coordinator

The SHSC is responsible for accompanying the OSHA Compliance Officer, answering all questions asked, and taking notes of the visit. The SHSC prepares the Report of an OSHA Inspection form with the assistance of the PM/FM. The SHSC maintains any records generated from the compliance visit.

4.5 SHE Coordinator

The SHE Coordinator in the office is responsible for locating and forwarding any employee records (e.g., training and medical clearances) not maintained on-site that are required by the Compliance Officer.

4.6 All On-site Field Staff

All on-site field staff are responsible for maintaining a safe work site. AEE and our subcontractors have a legal responsibility both to comply with specific standards and to provide "a place of employment free from recognized hazards." All on-site field staff will cooperate with the SHSC and Compliance Officer during an inspection.

5.0 PROCEDURE

5.1 Under the Act an OSHA Compliance Officer is authorized to:

- enter without delay and at reasonable times any factory, plant, establishment, construction site or other areas, workplace, or environment where work is performed by an employee or an employer
- inspect and investigate during regular working hours, and at other reasonable times, and within reasonable limits and in a reasonable manner, any such place of employment and all pertinent conditions, structures, machines, apparatus, devices, equipment and materials therein, and to question privately any such employer, owner, operator, agent or employee
- review records required by the Act and other records that are directly related to the purpose of the inspection

5.2 Opening Conference

Upon notification of the Compliance Officer's presence, an opening conference will be conducted. If the Compliance Officer does not offer an opening conference, the FM or SHSC will request one. During the opening conference, the Compliance Officer will explain the purpose and extent of the inspection.

- Be courteous and receptive to the Compliance Officer.
- Document the Compliance Officer's name(s), agency, and title from the Officer's credentials. Obtain a business card if available.
- Immediately locate the SHSC who will participate as the authorized AEE representative (and spokesperson) during the inspection. If at all possible, delay the opening conference and the "walk-around" inspection until the SHSC arrives.
- If site staff need additional guidance to prepare for the inspection, contact the Corporate SHE Director for assistance.
- Provide the Compliance Officer with all applicable visitor orientation information.
- Obtain the reason for the inspection and discuss any related information with the officer (e.g., intent to take photographs, obtain air samples, audit records, interview employees, inspect contractor activities, etc.).
- Escort the Compliance Officer at all times.

5.3 Commonly Requested Records for Inspection

At the opening conference the Compliance Officer may request various records that each facility must maintain for compliance purposes. These include, but are not limited to, the following:

- Completed OSHA Form 200 and/or 300, Supplementary 101 or 301 forms
- Employee Health and Safety Poster
- Training records
- Site-specific Health and Safety Plan
- Exposure monitoring data
- Hazard Communication Program including Material Safety Data Sheets
- Medical records (Physician's Clearance Forms)

Depending on the length of continuous fieldwork, the project site may or may not be classified as a separate establishment. Refer to Attachment 2, Table of Project Records, for descriptions of these records and where they can be obtained.

5.4 Inspection

The following should be attended to during the inspection:

- Take notes of the entire visit and write down as much as possible. These notes may be the basis for possible future action regarding the citation, penalty, or abatement period. Maintain a list of all materials required and/or copied for the Compliance Officer.
- Either during or immediately following the inspection, take pictures of the entire jobsite and any specific violation areas discussed. For certain locations, a photography pass may be required. Consult client for guidance, as necessary.
- If the Compliance Officer performs workplace monitoring during the inspection, the SHSC should perform monitoring in parallel. Arrangement can be made through the Corporate SHE Director for sampling equipment.
- Try to answer all questions specifically asked of you succinctly, yet tactfully; do not volunteer extra information.
- If unsure about the appropriate response to a question(s), either delay the response until the post-inspection conference, or ask the Compliance Officer for a "time out" to confer with the PM and Corporate SHE Director.
- Do not argue with the Compliance Officer or attempt to talk him/her out of recommending a citation and/or penalty. There will be other post-citation opportunities to justify our position with OSHA.

5.5 Complaint by an Employee

If the visit is the result of an employee complaint to OSHA, do not discriminate against the employee. The Compliance Officer should leave a copy of that complaint with the FM at this time. Attach it to the Report of an OSHA Inspection form.

5.6 Post-Inspection

At the end of the inspection, request a closing conference with the inspector; these are commonly conducted at a later date. Contact the Corporate SHE Director and Unit Manager for direction, additional information, and/or clarification of AEE policies, procedures, and programs.

The Compliance Officer does not typically leave paperwork at this time; however, discussion of the standards that were found to be violated is permitted. At this time, the Compliance Officer may ask how

long it will take to correct the violation. Be realistic with the abatement time; it may become part of a subsequent violation. Request that the Compliance Officer forward all copies of inspection reports, photographs, and monitoring results to the SHSC as they become available.

5.7 Citation and/or Penalty

If approved by the Area Director, a citation and/or proposed penalty will be mailed to the address provided in the opening conference. If a citation and/or penalty notice is received in the mail, immediately make a photocopy, fax the copy, and express mail the original to the Corporate SHE Director. Also, notify the Unit Manager immediately. Citations must be formally contested within 15 working days.

5.8 Posting of Citations

Follow the OSHA posting requirements as provided by the Corporate SHE Director. Post citations, even if contested, at or near each place of violation. If, because of the nature of the employer's operations, it is not practicable to post the citation at or near each place of alleged violation, such citation shall be posted, unedited, in a prominent place where it will be readily observable by all affected employees. Each citation shall remain posted until the violation has been abated, or for 3 working days, whichever is later.

5.9 Report Preparation

Upon departure of the Compliance Officer, the SHSC and PM/FM will summarize the inspection in writing using the Report of an OSHA Inspection form.

6.0 RECORDS

The Report of an OSHA Inspection, post-inspection reports, information received from the Compliance Officer, and citations shall be maintained in the project health and safety files by the SHSC. Copies shall also be distributed to the Unit Manager, Corporate SHE Director, and the Executive Vice President of Operations.

7.0 REFERENCES

1. Fed-OSHA. 1985. All About OSHA. OSHA 2056, (revised).
2. Moran, Robert D. 1987. *OSHA Handbook*. Government Institutes, Inc., Rockville, Maryland.
3. Fed-OSHA. 1995. 29 CFR 1903, *Inspections, Citations, and Proposed Penalties.*

TABLE OF PROJECT RECORDS	
1. OSHA 200/300 and 101/301	• For field project greater than 1 year (continuous) duration, these AMEC records are located on-site in the custody of SHSC. • For field project less than 1 year (continuous) duration, these AMEC records are maintained in electronic form at the centralized location by Corporate SHE Department. • Subcontractors must maintain respective copies of these records.
2. Employee Health and Safety Poster	• All projects should have poster prominently posted in the field trailer or with the SHE Coordinator.
3. Training Records	• Certification of HAZWOPER Training - refer to the project-specific Site Visit Form/Certification Letter or health and safety files maintained on-site by the SHSC. • Supporting documentation of HAZWOPER and other training records are maintained in electronic form at a centralized location in the custody of the Corporate SHE Director. Database printouts are also located at respective AMEC employees' home office in the custody of the SHSC. • Site-specific orientations - refer to the health and safety project binder in the custody of the SHSC for Visitor/Subcontractor Orientation(s) and Daily Tailgate Safety Meetings.
4. Medical Records	• Certification of HAZWOPER Medicals - refer to the project-specific Site Visit Form/Certification Letter or health and safety files maintained on-site by the SHSC. • Supporting documentation (Physician's Clearance forms) maintained at respective AMEC employees' home office in the custody of the SHE Coordinator. • Medical records are in the custody of the Medical Care Provider; employee access can be obtained via written request to the respective AMEC employees' home clinic.
5. Exposure Monitoring Data	• Health and safety project binder (Air Surveillance Records and/or Workplace Exposure Monitoring Records) held by the SHSC.
6. Hazard Communication and Material Safety Data Sheets (MSDS)	• Refer to the HazCom section in site-specific HSP and in the Standard Safe Work Practices appendix. Note that the written program is an SOP located in the Corporate SHE Manual (Volume VI) available at the nearest AMEC office from the SHE Coordinator. • MSDS are on file in the HSP and in the custody of the SHSC.
7. Site-Specific HSP	• On-site in the custody of the SHSC. • Be aware of the location of the following: HSP approvals on the Signature Page, Acceptance Page, record of change procedures and examples, Standard Safe Work Practices (Contractor rules), equipment inspections and certifications, and any evidence of enforcement.

OVERHEAD AND UNDERGROUND UTILITY

1. PURPOSE

This Procedure is to provide the minimum safety requirements and practices for working with or near overhead and/or underground utilities.

2. SCOPE

This Procedure applies to MACTEC employees at all offices, project sites and other locations where employees work with or near overhead and/or underground utilities. The following are examples of types of overhead and/or underground utilities: Electric power distribution and transmission systems, municipal electric systems, gas distribution and transmission systems, oil and petroleum products distribution and transmission systems, product or steam lines, telephone and telegraph systems, police and fire communications systems, cable television lines, and water, slurry, or sewer systems.

3. REFERENCES

29 CFR 1926 Subpart V – *Power transmission and distribution*

29 CFR 1910.145 – *Specifications for accident prevention signs and tags*

29 CFR 1910.333 – *Selection and use of work practices*

MACTEC Drilling Program (ESH 2.5.A)

MACTEC Hand and Power Tool Safety Procedure

MACTEC Ladders Procedure

MACTEC Excavation and Trenching Procedure

MACTEC Risk Assessment and Job Hazard Analysis Procedure

4. ACRONYMS AND DEFINITIONS

Alive or live (energized) - The term means electrically connected to a source of potential difference, or electrically charged so as to have a potential significantly different from that of the earth in the vicinity. The term "live" is sometimes used in place of the term "current-carrying," and may be used to avoid repetition of the longer term.

Barrier - A physical obstruction which is intended to prevent contact with energized lines or equipment.

Bond - An electrical connection from one conductive element to another for the purpose of minimizing potential differences or providing suitable conductivity for fault current or for mitigation of leak- age current and electrolytic action.

Cable - A conductor with insulation or a stranded conductor with or without insulation and other coverings (single-conductor cable) or a combination of conductors insulated from one another (multiple-conductor cable).

Communication Lines - The conductors and their supporting or containing structures which are used for public or private signal or communication service, and which operate at potentials not exceeding 400 volts to ground or 750 volts between any two points of the circuit, and the transmitted power of which

does not exceed 150 watts. When operating at less than 150 volts no limit is placed on the capacity of the system. **NOTE**: Telephone, telegraph, railroad signal, data, clock, fire, police-alarm, community television antenna, and other systems conforming with the above are included. Lines used for signaling purposes, but not listed above, are considered as supply lines.

Conductor - A material, usually in the form of a wire, cable, or bus bar suitable for carrying an electric current.

Dead (deenergized) - Free from any electrical connection to a source of potential difference and from electrical charges; not having a potential difference from that of earth. **NOTE**: The term is used only with reference to current-carrying parts which are sometimes live (energized).

Energized Circuits and Equipment - Any exposed energized conductors where a real hazard exists for shock, electrocution, or arc blast and includes exposed energized or rotating parts involving either direct contact or contact by means of tools, measuring instruments, materials, or work near enough to such circuits or equipment for employees to be exposed to any hazard they present. The degree of hazard for working on energized circuits and equipment can vary from non-existent to high depending on the specific voltage, current capacity of the circuit as well as the general work conditions.

Fault Current - The electrical current that flows through a circuit during an electrical fault condition. A fault condition occurs when one or more electrical conductors contact ground and/or each other. Types of faults include phase-to-ground, double-phase-to-ground, three-phase-to-ground, phase-to-phase, and three-phase. A Fault Current is several times larger in magnitude than the current that normally flows through a circuit.

Ground - A conducting connection, whether intentional or unintentional, between an electrical circuit or piece of equipment and the earth, or to some conducting body that serves in place of the earth (e.g., the human body). Grounding can be achieved by connecting a heavy wire between the ground terminal and the ground source.

Guarded - Protected by personnel, covered, fenced, or enclosed by means of suitable casings, barrier rails, screens, mats, platforms, or other suitable devices in accordance with standard barricading techniques designed to prevent dangerous approach or contact by persons or objects. Wires, which are insulated but not otherwise protected, are not considered as guarded.

Hazard Identification Tag - A tag that complies with 29 CFR 1910.145(f) used to identify a hazardous condition and provide a warning to employees with respect to a hazardous condition.

Hotline Tools - Tools and ropes which are especially designed for work on energized high voltage lines and equipment. Insulated aerial equipment especially designed for work on energized high voltage lines and equipment shall be considered hotline.

Hot Stick Distance - Refers to the distance from the hot end of hotline tools to the lineman when performing live-line work. Conductor support tools (such as link sticks, strain carriers, and insulator cradles) may be used provided the clear length of insulation is at least as long as the insulator string or as long as the minimum phase to ground distance

Job Hazard Analysis (JHA) – A study of a specific task or work assignment to (1) identify each step involved with a particular task, (2) identify the known or potential hazards associated with each step, (3) develop solutions that will eliminate, minimize, or control the hazards, and (4) identify residual risks (See MACTEC's Corporate ES&H Risk Assessment and Job Hazard Analysis Procedure); A systematic review

of any work activity focused on hazard identification and mitigation. This process is also known as a job safety analysis (JSA) or activity hazard analysis (AHA).

Licensed Electrician - An electrician who holds a valid license from the state (or other appropriate licensing body) where the work will be performed.

Local Health and Safety Representative (LHSR) - An individual appointed by the Office or Project Manager who has been assigned the responsibility of assisting in implementing the applicable requirements of all written ES&H policies, programs and procedures at a specific office or location.

Near - The term "near" includes conditions where contact with energized components is possible by slipping, tripping, falling, actions of others, or any other reasonably anticipated action.

Phase-to-ground - Electrical current that flows through a circuit during an electrical fault condition. A phase-to-ground fault condition occurs when one or more electrical conductors contact the ground.

Phase-to-Phase - Electrical current that flows through a circuit during an electrical fault condition. A phase-to-phase fault condition occurs when one or more electrical conductors contact each other.

Qualified Person - An individual who is familiar with the construction and operation of a particular piece of equipment and the hazards involved. Qualified persons are intended to be only those who are well acquainted with and thoroughly knowledgeable about the electrical equipment and the electrical hazards involved with the work being performed. It is possible that an individual can be "qualified" for one piece of equipment, but "unqualified" for another piece of equipment.

Underground Utility - Any pipe, conduit, duct, wire, cable, valve, line, fiber optic equipment, or other structure which is buried or placed below ground or submerged for use in connection with storage, conveyance, transmission or protection of electronics communication system, telephone or telegraph system, or fiber optic, electric energy, oil, natural gas, gases, steam, mixture of gases, petroleum, petroleum products, hazardous or flammable fluids/gases, toxic or corrosive fluids/gases, hazardous fluids/gases or other substances of like nature or water or water systems, sewer systems or traffic, drainage control systems, or other items of like nature.

5. REQUIREMENTS

5.1 General Safety Requirements

5.1.1 Existing conditions shall be determined before starting work, by an inspection or a test. Such conditions shall include, but not be limited to, energized lines and equipment, conditions of poles, the location of power and communication lines, gas utility lines, etc. The location of all utilities shall be clearly marked prior to the start of work. Appropriate markings, warning signs, barriers, etc. shall be promptly placed.

5.1.2 Operating voltage of equipment and lines shall be determined before working on or near overhead or underground utilities. All conductors and equipment shall be treated as energized until tested or otherwise determined to be deenergized. In the event that operating voltage can not be readily determined, employees shall stay a minimum of **35 feet** away from the line.

5.1.3 Protective grounds, guards, and/or barriers shall be applied on the disconnected lines or equipment to be worked on, as well as on adjacent energized lines by the utility company operating the line or a qualified electrician.

5.1.4 No employee shall be permitted to approach or take any conductive object without an approved insulating handle closer to exposed energized parts as indicated in **Table 1.**

Table 1 – Alternating Current – Minimum Clearance Distances

Voltage range (kilovolts)	Distance in feet and inches for maximum voltage	
	Phase to ground	Phase to phase
2.1 to 15	2'0"	2'0"
15.1 to 35	2'4"	2'4"
35.1 to 46	2'6"	2'6"
46.1 to 72.5	3'0"	3'0"
72.6 to 121	3'4"	4'6"
138 to 145	3'6"	5'0"
161 to 169	3'8"	5'6"
230 to 242	5'0"	8'4"
345 to 362	*7'0"	*13'4"
500 to 552	*11'0"	*20'0"
700 to 765	*15'0"	*31'0"

* For 345-362 kv., 500-552 kv., and 700-765 kv., minimum clear hot stick distance may be reduced provided that such distances are not less than the shortest distance between the energized part and the grounded surface.

5.2 Overhead Utilities

5.2.1 Equipment, such as drill rig masts, can easily contact overhead power lines. Keep all equipment and unqualified personnel away from power lines, poles, or towers according to the distances set forth in 29 CFR 1910.333(C)(3)(i)(A). This distance cannot be closer to any unguarded, energized overhead line than the following: for voltages to ground 50kV or below - 10 feet and for voltages to ground over 50kV - 10 feet plus 4 inches for every 10kV over 50kV. For example, for work around a 138,000 volt (138kV) overhead line, the minimum distance from the line shall be approximately 13 feet. A good rule of thumb: If the voltage of a powerline is known to be 50kV or less, stay 10 feet away from it. If the voltage is unknown or known to be greater than 50kV, stay 35 feet away from it.

5.2.2 When equipment is moving near or in proximity of an overhead utility line, a designated spotter must be used whose only responsibility is to ensure proper clearance from these overhead lines is maintained.

5.2.3 Portable metal or conductive ladders **shall not** be used near energized lines or equipment. (See the MACTEC Ladders Procedure).

5.2.4 With the exception of equipment certified for work on the proper voltage, mechanical equipment shall not be operated closer to any energized line or equipment than the clearances set forth in **Table 1** unless:

- An insulated barrier is installed between the energized part and the mechanical equipment by the utility company or by a qualified electrician; or
- The mechanical equipment is grounded or insulated; or

5.2.5 Lifting equipment shall be bonded to an effective ground or it shall be considered energized and barricaded when utilized near energized equipment, lines, or utilities.

5.3 Underground Utilities

5.3.1 Before beginning any earth moving operations, underground electric lines, gas lines, and other utility facilities shall be identified. When excavating, trenching, grading, or resurfacing around a power pole or tower, do not grade away the base as this can make these structures unstable (See the MACTEC Excavation and Trenching Procedure).

6. PROCEDURE

Step No.	Performer	Action
6.1	Project or Office Manager	• Ensure that employees are trained to the requirements of this Procedure, prior to assignment. Such training is to be performed by a qualified person. • Ensure employees have the training and knowledge to be capable of acting as a qualified person as defined in this Procedure. • Ensure that a Job Hazard Analysis (JHA) has been completed prior to the start of work. Re-evaluate the JHA if work conditions deviate from the original scope of activity. • Maintain training records and include the name of the trainer(s) and employee(s) trained, date(s) and topic(s) of training, and the type of hazard(s) addressed. Keep a copy in each employee personal and project file. • Address and document any employee reports of unsafe conditions. • Ensure that employees are provided and wear all required PPE.
6.2	Local Health and Safety Representative (LHSR) or Division ES&H Manager	• Provide aid in the implementation of this Procedure. • Ensure compliance with the requirements of this Procedure, as required.
6.3	Employee	• Receive training and comply with all of the requirements of this Procedure. • Notify a Supervisor if any unsafe conditions exist, and cease work until the hazards in question are addressed and corrected. • Wear the appropriate PPE for the duties performed.

6.3 (Cont.)	Employee (Cont.)	• Perform only those work tasks defined in the JHA for which you are trained, equipped and authorized. • Use approved grounding methods and release stored energy that pose a hazard to personnel.

7. RECORDS

All document generated as a result of the implementation of this Procedure shall be kept in the project file.

8. ATTACHMENTS

None

APPENDIX B

FIELD SAMPLING AND ANALYSIS PLAN

SAMPLING AND ANALYSIS PLAN
TOWER AUTOMOTIVE OPERATIONS USA I, LLC
81 DRETTMANN DRIVE
ELKTON, MICHIGAN

AMEC Project No. 7-6797-0010

Prepared for:

Tower Automotive Operations USA I, LLC

Prepared by:

AMEC Environment & Infrastructure, Inc.
46850 Magellan Drive, Suite 190
Novi, Michigan 48388

January 31, 2013

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1.0 INTRODUCTION

The Sampling and Analysis Plan (SAP) has been prepared for the Tower Automotive Operations USA I, LLC (Tower) facility located at 81 Drettmann Drive in the village of Elkton, Michigan (Site). The location of the Site is depicted in **Figure 1** of the polychlorinated biphenyl (PCB) Remedial Action Work Plan (WP). The SAP is required to document the validity of field and laboratory data produced through field activities, which are part of the WP. The SAP will outline sampling rationales, field methods and procedures, and laboratory analytical methods to be implemented during remedial activities.

1.1 Site Background

Manufacturing operations began at the Site in approximately 1945. Active Tool and Manufacturing Co, Inc. operated the facility from approximately 1945 until 1999 at which time Tower Automotive, Inc. acquired the Site. Tower purchased the facility and operations out of bankruptcy from Tower Automotive, Inc. on July 31, 2007.

Historical operations at the Site have resulted in several accidental releases and subsequent subsurface impacts. Investigations have been conducted at the Site from 1989 to 2004. In June 2012 AMEC completed additional investigational sampling to further characterize and define impacts to soil, groundwater and/or sediment across the Site.

Nine AOCs have been identified at the Site, six of which require corrective action. Tower plans to complete remedial activities, including removal of PCB contaminated soils, in six of the AOCs (i.e., AOCs 1, 2, 4, 7, 8, and 9). The AOCs are summarized in **Table 1** and are depicted in **Figure 2** of the WP.

1.2 Site Characterization Activities

This SAP has been compiled to address existing PCB impacts identified in AMEC's October 2, 2012 *Final Polychlorinated Biphenyl Site Characterization Report* (SCR). The SCR was submitted to USEPA for review and approval. The screening criterion for each AOC was designated during the Site Characterization phase.

2.0 REMEDIAL APPROACH

In order to reduce PCB concentrations below required TSCA PCB cleanup levels in each AOC, PCB contaminated soil will be removed and disposed at a designated disposal facility. Prior to backfill and compaction of the excavated area, verification samples will be collected to document that remaining soil is below the proposed cleanup standard. It is estimated that 219 verification samples will be collected. However, the actual number of verification samples will be adjusted based on final excavation areas.

2.1 AOC 1 – Paint Shed Area

Analytical data from historic soil samples revealed soil impacted with PCBs above the 1 part per million (ppm) screening criteria within AOC 1. Soils exhibiting concentrations of PCBs greater than 1 ppm will be excavated from AOC 1. The estimated volume of soil to be removed from AOC 1 is 1 cubic yard. Verification samples will be collected per the requirements of 40 CFR 761.283. The samples will be composited at no more than a 4:1 ratio following general requirements of 40 CFR 761.289. The number of samples collected will be based on the final excavation limits, but is expected to be approximately 3 samples for AOC 1.

2.2 AOC 2 – South Courtyard

Analytical data from historic and current soil samples reveal soil impacted with PCBs above the 25 ppm screening criterion within AOC 2. Soils exhibiting concentrations of PCBs greater than 25 ppm will be excavated from AOC 2. The estimated volume of soil to be removed from AOC 2 is 50 cubic yards. Verification samples will be collected per the requirements of 40 CFR 761.283. The samples will be composited at no more than a 4:1 ratio following general requirements of 40 CFR 761.289. The number of samples collected will be based on the final excavation limits, but is expected to be approximately 32 samples for AOC 2.

2.3 AOC 4 – North Courtyard

Analytical data from historic and current soil samples reveal soil impacted with PCBs above the 1 ppm screening criterion within AOC 4. Soils exhibiting concentrations of PCBs greater than 1 ppm will be excavated from AOC 4. The estimated volume of soil to be removed from AOC 4 is 67 cubic yards. Verification samples will be collected per the requirements of 40 CFR 761.283. The samples will be composited at no more than a 4:1 ratio following general requirements of 40 CFR 761.289. The number of samples collected will be based on the final excavation limits, but is expected to be approximately 44 samples for AOC 4.

One monitoring well (MW-2) was installed adjacent to the drainage ditch in AOC 4. Analytical results from the groundwater sample collected from MW-2 revealed no detections of PCBs above the laboratory reporting limit of 0.00030 mg/l. Therefore, AMEC recommends no further action regarding MW-2 at this time.

2.4 AOC 5 – West Courtyard

Analytical data from current soil samples revealed no soil impacted with PCBs above the 1 ppm screening criterion within AOC 5 from 0 to 0.5 feet bgs. Based on the analytical results, no remedial work to address PCB contamination is recommended for AOC 5.

2.5 AOC 6 – Former Oil/Water Separator

Analytical data from current soil samples revealed no soil impacted with PCBs above the 1 ppm screening criterion within AOC 6 from 0 to 0.5 feet bgs. Based on the analytical results, no remedial work to address PCB contamination is recommended for AOC 6.

2.6 AOC 7/8 – Drainage Ditch Area

Analytical data from historic and current soil samples reveal soil impacted with PCBs above the 1 ppm screening criterion within AOC 7/8. Soils exhibiting concentrations of PCBs greater than 1 ppm will be excavated from AOC 7/8. The estimated volume of soil to be removed from AOC 7/8 is 264 cubic yards. Verification samples will be collected per the requirements of 40 CFR 761.283. The samples will be composited at no more than a 4:1 ratio following general requirements of 40 CFR 761.289. The number of samples collected will be based on the final excavation limits, but is expected to be approximately 114 samples for AOC 7/8.

2.7 AOC 9 – Drainage Ditch Sediments

Analytical data from historic and current soil samples reveal soil impacted with PCBs above the 1 ppm screening criterion within AOC 9. Sediments exhibiting concentrations of PCBs greater than non-detect will be excavated from AOC 9. The estimated volume of soil to be removed from AOC 9 is 346 cubic yards. Verification samples will be collected per the requirements of 40 CFR 761.283. The samples will be composited at no more than a 4:1 ratio following general requirements of 40 CFR 761.289. The number of samples collected will be based on the final excavation limits, but is expected to be approximately 26 samples for AOC 9.

3.0 FIELD METHODS AND PROCEDURES

3.1 Utility Location and Clearance

Prior to the start of excavation activities, “MISS DIG”, the Michigan one call utility clearance hot line, will be contacted to mark public underground utilities in the vicinity of the proposed soil boring locations. In addition, a private utility clearance contractor will be utilized to mark facility-owned underground utilities and clear proposed soil boring locations.

3.2 Excavation Activities

As discussed in the WP, remedial action activities will include excavation and removal of PCB contaminated soil and sediment, installation of an enclosed storm sewer in place of existing drainage ditch, replacement of existing enclosed storm sewer, and site restoration. Excavation areas are depicted on **Figures 4 through 7** and excavation volumes are summarized in **Table 3** of the WP.

3.3 Soil Field Screening

Excavations and excavated soil will be observed for evidence of impacts (i.e., odor, staining, sheen, and free product). Soil and excavations will also be screened for the presence of VOCs using a photoionization detector (PID). Readings and observations will be recorded in the field book.

3.4 Verification Sample Collection

A five by five foot grid will be placed over each AOC for the collection of floor verification samples. The grids will extend vertically in one foot increments for the collection of side wall samples. Verification samples will be composited at no more than a 4:1 ratio following general requirements of 40 CFR 761.289 Subpart O. It is expected that the excavation depth will not necessarily be consistent throughout an entire excavation area. Verification floor samples composites will not consist of floor samples from different depths. Verification sample composites will not combine floor samples and side wall samples. If verification sample analytical results are above proposed cleanup standard for the AOC, additional soil will be removed and new verification samples will be collected.

Soil samples collected from the floor and walls of excavated areas will be collected using stainless-steel trowels. The trowel will be decontaminated and checked for defects prior to collection of each soil sample. A description of the location of the sampling area, field observations, and sample description will be recorded in a field logbook. Soil samples will be collected with a decontaminated trowel and placed into a decontaminated stainless steel bowl. The sample will be homogenized in the stainless-steel bowl, placed in a laboratory-supplied container, properly labeled, and stored in an iced cooler prior to shipment to the laboratory.

Container labels will provide the following information, if applicable:

- Site name

- Sample identification
- Date and time of sample collection
- Name of sampler
- Sample preservation
- Type of analysis

The samples will be transported under proper chain-of-custody procedures to the laboratory. Soil samples will be analyzed for PCBs using United States Environmental Protection Agency (USEPA) Method 8082.

3.5 Soil Sample Identification

The samples will be identified by the grid overlaid on **Figures 4 through 7** of the WP. Each sample will be identified by AOC and will have a corresponding letter and a number using the grid. For example, a floor sample in AOC 2 composited from the floor of grid squares A5, A6, B5, and B6 at 6 inches bgs would be labeled as AOC2-A5-A6-B5-B6-FL6". In addition, a sidewall in AOC 2 composited from the wall of grid squares F5, F6, F7 and F8 at 0-1 ft bgs would be labeled as AOC2-F5-F6-F7-F8-SW0-1'.

After each sample is labeled, the identical information from the label will be transferred to a chain-of-custody form. The chain-of-custody form is a serialized document, and a summarization form for the analytical laboratory to track samples.

3.6 Shipping Procedures

Immediately following sample collection, labeled sample containers will be placed in an insulated cooler. Plastic bags containing crushed ice will be placed in coolers so that samples will be maintained at or below 4°C. Glass containers will be wrapped with bubble wrap or other appropriate padding to prevent breakage during transport.

Samples will be shipped within 24 hours to allow the laboratory to meet holding times for analyses. Prior to shipment, ice will be replaced to keep samples at or near 4°C during transport. The chain-of-custody record will be placed in a sealed bag and taped to the inside top of the cooler. The cooler will be sealed with packing tape and a chain-of-custody seal will be applied across the lid sealing point. Coolers will be properly labeled with job name, job number, date, time, contact name, and phone number.

3.7 Field Equipment Calibration

Calibration of field instruments will be performed at the intervals specified by the manufacturer or more frequently as conditions require. A PID will be used for field screening and air monitoring purposes for personnel protective measures. The PID will be calibrated daily using ambient air and isobutylene calibration gas (100 ppm). Record of the calibration results will be documented in the field book.

3.8 Decontamination Procedures

To prevent cross-contamination of samples, field personnel will don clean, disposable, powder-free nitrile gloves prior to collecting each soil sample. Field personnel will decontaminate stainless-steel hand trowels and bowls between sample locations. Decontamination of sampling equipment will follow the U.S. EPA *Region IV Science and Ecosystem Support Division, Operating Procedure, Field Equipment Cleaning and Decontamination, SESDPROC-205-R1, December 2011.* Sampling equipment that directly contacts sample media will be cleaned using the following procedure:

1. Wash with potable water and a brush to remove particulate matter;
2. Wash with Alconox (or equivalent) and potable water or distilled water;
3. Rinse with deionized water;
4. Rinse with hexane solution;
5. Rinse with deionized water; and
6. Allow to air dry as long as practical before using.

The sampling equipment will then be wrapped with aluminum foil for transport to the next sampling location. A decontamination pad will be constructed on-site using polyethylene sheeting and lumber, or equivalent to collect fluids produced during decontamination activities. Decontamination fluids will be containerized in steel 55-gallon drums and managed in accordance with **Section 3.9**.

3.9 Management of RDW

Remediation derived waste (RDW) includes decontamination fluids, soil cuttings, and personal protective equipment (PPE). RDW will be handled, stored, transported, and disposed off-site in accordance with the Toxic Substances Control Act (TSCA) 40 Code of Federal Regulations (CFR) Part 761 established by the USEPA.

Decontamination fluids will be collected and contained in labeled, secured, steel 55-gallon drums. A “pending analysis” label will be placed on each drum. The drums will be labeled with the following information: contents, capacity (*i.e.* full or ¾ full), source area, and date generated. Drums will remain on-site in a secure area designated by facility personnel, pending the results of laboratory testing. Samples will be collected for the decontamination fluids and analyzed for PCBs. Appropriate disposal methods for these drums will be determined after reviewing the analytical results. Characterization, transport, and disposal of decontamination fluids will be completed within 30 days of the completion of field activities.

PPE will be collected in 55-gallon drums or bulk containers and will be disposed with stockpiled material. All soil removed from site will be treated as TSCA waste and disposed of in a TSCA approved Subtitle C landfill in accordance with 40 CFR § 761.61(a)(5)(v). Existing characterization data is expected to be used for waste characterization prior to disposal.

4.0 QUALITY ASSURANCE/QUALITY CONTROL PROCEDURES

Sampling activities will follow the procedures and quality assurance/quality control protocols stated in the QAPP presented in **Appendix B** of the WP. Additional QA/QC measures to be accomplished are discussed herein.

4.1 Quality Assurance/Quality Control Samples

Quality Assurance/Quality Control (QA/QC) of the samples is performed by the analytical laboratory during and after analysis. Records of the QA/QC process are included in the analytical report from the laboratory for review. A field duplicate samples will be collected at a frequency of one sample per every 10 samples collected. A matrix/matrix spike duplicate (MS/MSD) sample will be collected at a frequency of one sample per every 20 samples collected.

4.2 Chain-of-Custody Procedures

Chain-of-custody (COC) procedures will be used to establish, document, and maintain custody of field samples. A complete COC record will accompany samples while in the field, during shipment to the laboratory, and during analysis. When transferring samples, the individuals relinquishing and receiving will sign, date, and note the time on the COC record. Two copies (including the original) of the COC record will accompany the samples to the laboratory. One copy of the COC record will remain with the field team. The following information will be provided on the COC form:

- Site name
- Sample identification
- Date and time of sample collection
- Name and signature of sampler
- Sample preservation
- Matrix
- Type of analysis
- Signature(s) of individual involved in sample transfers
- Delivery of samples to the laboratory and storage at 4°C or below

A chain-of-custody form is provided in **Attachment A**.

4.3 Documentation

Dedicated field logbooks will be maintained by field personnel throughout the duration of the project. Pertinent information regarding on-site activities will be recorded in the field logbooks. Pertinent information includes, at a minimum, dates, names and details of on-site personnel, detailed descriptions of field activities, sampling activities, field measurements, sample locations, equipment calibrations, and problems encountered. Information recorded in the field logbooks will be entered with an indelible black or blue ink pen. Logbooks shall be permanently bound with sequentially-numbered pages. Each page will be signed and dated by the personnel

documenting the on-site activities. Corrections shall be made by crossing out the error with a single line, and initialing and dating the correction.

Photographs will be taken to document field activities and site conditions. A description of each photograph will be recorded in the field book.

ATTACHMENT A

Field Forms

Chain-Of-Custody

AMEC Earth & Environmental Inc.
10524 East Grand River Ave, Suite 104
Brighton, Michigan 48116
810-220-8941, 810-220-8947 f

Site ID:
Project Number:
Location:

Laboratory:

Report Results to:

Turnaround Time:_____

Preservative Codes		
0=No Preservative	4=Sodium Thiosulfate	Note→
1=Hydrochloric Acid	5=Sodium Hydroxide	Pres.
2=Nitric Acid	6=Methanol	Code
3=Sulfuric Acid	7=Ice	
	8=Other	

Matrix Codes:		
GW=Groundwater	SO=Soil	LIQ=Liquid
WW=Waste Water	SL=Sludge	
SW=Surface Water	OI=Oil	
	SOL=Other Solid	

Sample Identification	Container		Sample Collection			Type	Matrix	Methods For Analysis							
	Number	Type	Date	Time	Sampler	Comp or Grab	Code								

Relinquished by:	Date/Time:	Received By:	Date/Time:	Comments:
Relinquished by:	Date/Time:	Received By:	Date/Time:	
Relinquished by:	Date/Time:	Received By:	Date/Time:	

APPENDIX C

QUALITY ASSURANCE PROJECT PLAN

QUALITY ASSURANCE PROJECT PLAN
TOWER AUTOMOTIVE OPERATIONS USA I, LLC
81 DRETTMANN DRIVE
ELKTON, MICHIGAN

AMEC Project No. 7-6797-0010

Prepared for:

Tower Automotive Operations USA I, LLC

Prepared by:

AMEC Environment & Infrastructure, Inc.
46850 Magellan Drive, Suite 190
Novi, Michigan 48377

January 31, 2013

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ACRONYMS

°C	degrees Celsius
%R	percent recovery
AMEC	AMEC Environment & Infrastructure, Inc.
ASTM	American Society for Testing and Materials
CCV	continuing calibration verification
CFR	Code of Federal Regulations
CLP	Contract Laboratory Program
COC	chain-of-custody
DQI	data quality indicator
DQO	data quality objective
g	gram
GC/ECD	gas chromatograph/electron capture detector
GC/ELCD	gas chromatograph/electrolytic detector
ICAL	initial calibration
LCS	laboratory control sample
LIMS	laboratory information management system
MDL	method detection limit
mg/kg	milligrams per kilogram
mL	milliliter
MQO	measurement quality objective
MS	matrix spike
MSD	matrix spike duplicate
NIST	National Institute of Standards and Technology
PCB	polychlorinated biphenyl
pdf	portable document format
PID	photoionization detector
ppm	part per million
QA	quality assurance
QAM	quality assurance manual

QAPP	quality assurance project plan
QC	quality control
RL	reporting limit
RPD	relative percent difference
RSD	relative standard deviation
SAP	Sampling and Analysis Plan
SDG	sample delivery group
SOP	standard operating procedure
Tower	Tower Automotive Operations USA I, LLC
USEPA	United States Environmental Protection Agency
WP	Work Plan

1.0 INTRODUCTION

This Quality Assurance Project Plan (QAPP) has been prepared on behalf of Tower Automotive Operations USA I, LLC (Tower) to support generation of soil data under activities specified in the *Remediation Work Plan* (WP) and described in the *Sampling and Analysis Plan* (SAP). This QAPP describes data quality needs of the Tower project, and the quality control (QC), quality assurance (QA), and data management activities needed to achieve these data quality needs.

This QAPP has been prepared following guidance from the United States Environmental Protection Agency (USEPA) (USEPA, 1992 *et subsequent*, 1996, 2002a, 2002b, 2006, 2007, and 2008).

2.0 DATA QUALITY OBJECTIVES AND INDICATORS

2.1 Project Data Quality Objectives

The primary data quality objective (DQO) supported by this QAPP is production of chemical analysis data of known and sufficient quality.

Definitive data are required to achieve this DQO, and strict adherences to requirements of this document are required so that the data are of known and sufficient quality. The data quality indicators (DQIs) and measurement quality objectives (MQOs) discussed in the following section of this document will be used to control data quality, laboratory compliance with DQI goals, and analytical methodology requirements. Good laboratory practice will be assessed during the data verification and validation procedure.

Field measurement of chemical and physical parameters and the subsequent results will be used to assess Site conditions for worker's health and safety. Field measurement QC procedures are discussed in the manufacturer's manual.

2.2 Data Quality Indicators

The DQIs presented in this section are: precision, accuracy, representativeness, comparability, completeness, detectability, and the additional indicator of selectivity. Precision, accuracy, representativeness, comparability, completeness, and detectability can be applied to both field and laboratory analytical measurements to document that data of known and appropriate quality are obtained to support specific decisions or regulatory actions. Selectivity is a DQI that applies specifically to laboratory data to document that reported data are representative of the reported compound, and not of a positive or negative artifact. Discussion of the Project DQIs in this QAPP will be limited to their application and goals for purposes of the Tower project. Except where specified, the numerical DQI goals discussed below are not intended to be used as absolute criteria for acceptance or rejection of data, but rather as guidance to indicate when further evaluation of data quality is needed.

2.2.1 Precision

Precision is the degree of agreement between or among independent, similar, or repeated measures. Precision will be measured as the relative percent difference (RPD) between duplicate analyses when analyte concentrations are greater than five times the reporting limit (RL) or, if analyte concentrations are less than five times the RL, the absolute difference between analyte concentrations is less than the RL.

When analyte concentrations are more than five times the RL, precision will be calculated as the RPD as follows:

$$\%RPD_i = \left(\frac{2 \times \left| O_i - D_i \right|}{\left(O_i + D_i \right)} \right) \times 100$$

Where:

$\%RPD_i$ = Relative percent difference for compound i

O_i = Concentration of compound i in original sample or matrix spike (MS)

D_i = Concentration of compound i in duplicate sample or matrix spike duplicate (MSD)

The laboratory precision MQO will be less than 50% RPD between duplicate analyses.

If this MQO is not met, the laboratory will investigate the cause of the exceedance and include a discussion of the exceedance and impact on data usability in the case narrative. If the cause of the MQO exceedance is determined to be laboratory error, the laboratory will reprepare and/or reanalyze the sample as appropriate.

Precision related to sample collection in the field will be monitored using field duplicates. The RPD between field duplicates for samples with analyte concentrations greater than the RL will be less than or equal to 50% for soil and groundwater samples. The absolute concentration difference between duplicate samples with concentrations less than five times the RL will be less than or equal to the corresponding RL. If this MQO is exceeded, the contractor will investigate possible causes of imprecision between field duplicate samples and will discuss the results of the investigation and effect on data usability in the data quality evaluation report.

2.2.2 Accuracy

Accuracy is the degree of agreement between a measured value and the true value. It will be monitored as the percent recovery (%R) of the MS and/or the MSD, laboratory control samples (LCSs), internal standards, and surrogate spike compounds.

Accuracy will be calculated as the %R of analytes as follows:

$$\%R_i = \left(\frac{Y_i}{X_i} \right) \times 100$$

Where:

$\%R_i$ = percent recovery for compound i

Y_i = measured analyte concentration in sample i (measured - original sample concentration)

X_i = known analyte concentration in sample i

Project-specific MQOs for each type of accuracy control sample are discussed below and will be applied unless an analytical method contains defined performance criteria for the MQO.

The MQO for organic analyte surrogate spike recovery in all samples (including MS/MSDs, LCSs, and all blanks) is 30% to 150% of the known value. Recovery in this range should be routinely achievable for LCSs as the spike is added to an interference-free matrix.

Sporadic failure of an organic analyte to meet the 30% to 150% recovery goal may be tolerated as long as the recovery is greater than 10%. The laboratory is required to re-extract and reanalyze field and QC samples associated with LCS recoveries less than 10%. If requested, the laboratory must provide proof that analytes with QC limit exceedances are random events and do not indicate systematic analyte recovery problems.

The laboratory case narrative must include a discussion of the effect of organic analyte recovery outside the QAPP-specified MQO on data usability.

The MQO for recovery of analytes and surrogate compounds spiked into the sample matrix (i.e., MS/MSDs) is 29% to 135%. Recoveries outside these limits must be reflective of the sample matrix rather than laboratory procedural bias, and that matrix-related recovery problems are adequately documented in the laboratory report and raw data. Compliance with this MQO will be assessed by comparison of analyte and surrogate recovery in the sample matrix to laboratory performance on method blanks and LCSs, and by results of the data quality review process.

2.2.3 Representativeness

Representativeness is the degree to which data accurately and precisely represents a parameter variation at a sampling point or an environmental condition. The results of analyses will be used to evaluate the data to determine whether the sample data appropriately describe the investigated area.

The collection of representative samples will be achieved by following field procedures outlined in the project SAP. Representativeness of laboratory data will be achieved by thoroughly mixing soil samples prior to removal of analytical subsamples.

2.2.4 Comparability

Comparability is the degree to which data from one study can be compared with data from other similar studies, reference values (such as background), and screening values. Comparability of samples will be achieved by following the field procedures outlined in the project SAP. Comparability of laboratory results will be achieved by following standardized analytical procedures, using traceable reference materials, using Class A volumetric glassware, or correctly calibrated pipettors for volumetric procedures, using correctly calibrated balances for gravimetric procedures, and following good laboratory practices.

2.2.5 Completeness

Completeness is defined as the percentage of usable data out of the total amount of data generated. Analytical completeness is determined after review of the analytical data by comparing the number of overall accepted analytical results (valid results), including estimated values, and excluding rejected data, to the total number of analytical results requested on samples submitted for analysis.

Therefore, the MQO for completeness as a whole shall be 98%. Completeness for project-specific data needs shall be 95% for each individual method. Project-specific data needs will be defined on an individual batch basis and will consist of data for which QC criteria were met.

Completeness will be calculated as follows:

$$\%C = \frac{A}{I} \times 100$$

Where:

%C = Percent completeness (analytical)

A = Actual number of samples collected/valid analyses obtained

I = Intended number of samples/analyses requested

Rejection of data due to severe matrix interference is sometimes unavoidable, but the project laboratory should make an effort to minimize these problems, if possible, and document steps taken to do so.

Rejection of data due to laboratory performance issues typically is unacceptable. Project laboratories are expected to pay careful attention to analytical procedures and method requirements, to implement corrective actions to avoid rejection of results, and to proactively communicate when problems are identified.

2.2.6 Detectability

As used in this context, detectability refers to the ability of project analytical procedures to identify and quantify target analytes at concentrations low enough to meet project data needs. Specific indicators of detectability in analytical measurement include RLs and method detection limits (MDLs).

The MDL is a purely statistical value, determined by the analysis of seven or more low-level replicate samples. The MDL is defined by USEPA as the concentration at which an analytical system has a 99% probability of avoiding false positive results. The MDL lies in a region of high quantitative uncertainty and results near the MDL must be considered estimated values. The laboratory shall not report concentrations less than the MDL as detections.

The RL is normally set at a factor five to ten times the MDL. The exact number depends on the minimum concentration that a laboratory can successfully use as the lowest calibration standard. The RL is considered the lowest concentration that a lab can report with reasonable quantitative accuracy, although results less than five times the RL can still be highly variable.

In a practical sense, adequate detectability requires the absence of false positive and false negative signals near the RL, or near the MDL in cases where the RL exceeds an applicable regulatory or screening level. Laboratory blank concentrations will be used to assess the possible effects of false positive results on reported analytical results for field samples. The DQI goal for blank results is that no blank should contain detectable target analyte concentrations.

Laboratory blank results that exceed the RL will require re-preparation and re-analysis of affected samples, while laboratory results that exceed the MDL require evaluation on a case-by-case basis. It must be noted that blank concentrations that consist of a negative number that exceeds the negative RL or the negative MDL are considered to exceed the corresponding limit.

The definition of an MDL limit in 40 Code of Federal Regulations (CFR) 136 Appendix B states that the MDL represents the minimum concentration of a substance that can be measured and reported with 99 percent confidence that the analyte concentration is greater than zero. As such, it is the responsibility of the project laboratory to document that the MDL is in fact achievable on a routine basis. Evidence that the laboratory cannot routinely achieve the stated MDL for an analyte will consist of a pattern of results, with an absolute value greater then or equal to the MDL for that analyte in multiple laboratory blanks.

For the purpose of the Tower project, the primary DQI goal for detectability is that the laboratory RL be less than or equal to 1 milligram per kilogram (mg/kg) or 1 part per million (ppm) for Aroclors.

Project laboratories are expected to make an effort to avoid excessive dilution, and to preserve RLs or MDLs that are low enough to meet project needs. If a sample must be diluted more than 10-fold due to matrix interference, and not because of elevated target analyte concentration(s), the laboratory shall notify the contractor before proceeding. Project laboratories are expected to use additional cleanups rather than dilutions to manage matrix effects whenever possible.

2.2.7 Selectivity

The DQI of selectivity refers to the ability of determinative analytical procedures to correctly identify an analyte when it is present, and to discriminate between the analyte and potential interferences. The MQO for data generated as part of activities specified in the project WP is to minimize or eliminate the reporting of false positive and false negative results by the project laboratories.

The MQO for selectivity will be accomplished by: (1) using proper preparation and cleanup procedures, as specified in Table 1; (2) using confirmation analyses, such as second column confirmation or mass selective detection confirmation, when target analytes are detected; (3) requiring that the project laboratory maintain their analytical systems in proper working procedure by following the preventative maintenance schedules outlined in their Quality Assurance Manual (QAM); and, (4) requiring that the project laboratory strictly follow method requirements for compound identification. Proper compound identification will be monitored

during data validation, and the project laboratory will be required to provide additional explanation for questionable compound identification.

Table 1: Analytical Method, Sample Preparation Methods, and Cleanup Method

Analyte	Method Reference	Preparatory Method	Cleanup Method	Instrument/Detector
Polychlorinated Biphenyls (PCBs)	USEPA SW-846 Method 8082A	Solids: USEPA SW-846 Methods 3540C, 3541, 3545A, 3546, 3550C, or 3562	USEPA SW-846 Method 3665A	Gas chromatograph/ electron capture detector (GC/ECD) or GC/electrolytic detector (ELCD)

It is expected and required that the laboratory will appropriately flag, as being presumptively identified, data generated from a response that does not meet required identification criteria. It is also expected that the laboratory will document the reason for rejection of results in the raw data when examination of the sample spectrum indicates that the compound appears to be present.

3.0 SAMPLING DESIGN, FIELD PROCEDURES, AND CHAIN-OF-CUSTODY

Sampling design and field procedures for the Tower project are discussed in detail in the project WP and project SAP. Observations of field activities related to data collection are integral to comprehensive data evaluation. Field forms and notes should be up to date with respect to: samples to be collected, sample IDs, QA/QC sample collection requirements, and analytical laboratory information.

Samples will be maintained under proper chain-of-custody (COC) protocols while in the field, until receipt by the lab. Samples will be stored in coolers containing sufficient ice to keep samples at a temperature of 4 degrees Celsius (°C) until shipped. Completed (signed and dated) COC forms will be retained with the respective samples at all times.

Samples will be submitted to the project laboratories on a daily basis during sample collection events. Once at the laboratory, if analytical holding times permit, the laboratory will be directed to group the samples into sample delivery groups (SDGs) of 20, or fewer, field samples. Grouping the samples in sets of 20 allows efficient reporting of results, and facilitates the data verification and validation process because laboratory batches and associated QC are based on groups of 20 samples.

4.0 SAMPLE COLLECTION AND PRESERVATION

Sample locations, sample collection procedures, and sample preservation are specified in the project SAP. A summary of the sampling requirements, including laboratory containers, sample volumes, preservation, and holding times is provided below.

Table 2: Laboratory Container, Preservation, and Holding Time

Analyte	Method Reference	Minimum Volume	Container	Preservation	Holding Time
PCBs	USEPA SW-846 Method 8082A	Solids: 30 grams (g)	Solids: 125 milliliter (mL) glass jar with Teflon-lined lid	Cool to 4°C ± 2°C	14 days from sample collection until extraction. 40 days from extraction until analysis.

5.0 QUALITY CONTROL PROCEDURES AND CORRECTIVE ACTIONS

In order to attain data of sufficient quality to support project DQOs, specific procedures are required to allow evaluation of data quality. These procedures and requirements for their evaluation are described in this section.

5.1 Field Quality Control

Evaluation of field sampling procedures requires the collection and evaluation of field QC samples. Field duplicates will be collected and submitted to the analytical laboratory to provide a means of assessing the quality of data resulting from the field sampling program.

Field duplicates are collocated samples that are collected simultaneously or sequentially in separate containers. The purpose of field duplicates is to allow evaluation of the contribution of random error from sampling to the total error associated with the data. One set of field duplicates will be collected and submitted for every ten field samples collected. If less than ten field samples are collected, field duplicates will be collected and submitted on a daily frequency. Field duplicate precision will be evaluated as described in Section 2.2.1 above.

5.1.1 Calibration Requirements

Field-based analytical instruments, such as photoionization detectors (PIDs), must be calibrated following manufacturers' instructions and frequency recommendations before they may be used for data collection.

5.2 Laboratory Quality Control

Laboratory QC samples are used to monitor the laboratory's precision and accuracy of the analytical procedure results. Laboratory QC samples (method blanks, LCS, and surrogate spikes) are analyzed as part of the standard laboratory QC protocols. A summary of required laboratory QC samples is presented in Table 3.

Table 3: Laboratory Quality Control Sample Summary

Method	Method Blank	LCS	MS/MSD	Surrogate Spikes	Initial Calibration	Continuing Calibration Standard
USEPA SW-846 Method 8082A	1/batch (20 samples)	1/batch (20 samples)	1/batch (20 samples)	All samples, MS/MSDs, LCSs, and blanks	Minimum 5-point	Required at the beginning and end of the analytical sequence, and after each group of 20 samples

Sections 5.2.1 through 5.2.4 describe each lab QC sample in detail.

5.2.1 Method Blanks

Method blanks will be used to assess the potential existence and magnitude of laboratory background contamination. Method blanks will be analyzed with each sample batch. Results will be compared to samples in the analytical batch.

QC criteria require that no contaminants be detected in the blank(s) at concentrations greater than the RL. If an analyte is detected, the action taken will follow the laboratory standard operating procedures (SOPs) and QAM. Blank samples will be analyzed for the same parameters as the associated field samples.

5.2.2 Laboratory Control Samples

LCSs are used to monitor the laboratory's day-to-day performance of routine analytical methods, independent of matrix effects. The LCS must contain Aroclor 1016 and Aroclor 1260 at a minimum, and LCSs must undergo the same preparation, cleanup (if used), and analyses as the associated field samples. Results are compared on a per-batch basis to pre-established recovery goals and are used to evaluate laboratory performance for precision and accuracy.

The goal for recovery of analytes spiked into the LCS is 50-150%. Compliance with this goal will be assessed by comparison of analyte recovery in the LCS with compliance standards.

5.2.3 Matrix Spike/Matrix Spike Duplicate

MS and MSDs are used to evaluate analytical (preparation and analysis) precision and accuracy (Section 2.2.1 and Section 2.2.2). The MS/MSDs will be collected and analyzed at a rate of 1 per 20 of the primary samples.

Because MS/MSD samples measure the effect of a specific sample matrix on analyte recovery, only MS/MSD samples from this investigation will be evaluated, and not samples from other projects. The MS/MSD samples will be analyzed for the same parameters as the primary samples in the same QC analytical batch and will be spiked with target analytes. Results will be expressed as a percent recovery of the known spiked amount and as a RPD for the MS/MSD pairs.

The goal for recovery of analytes spiked into the sample matrix is that recoveries less than 29% or greater than 135% for organic analytes must be reflective of the sample matrix rather than procedural bias, and that matrix-related recovery problems are adequately documented in the laboratory report and in the raw data. Compliance with this goal will be assessed by comparison of analyte and surrogate recovery in the sample matrix with laboratory performance on method blanks and LCSs.

5.2.4 Surrogate Spikes

Surrogate spikes are used to evaluate accuracy, method performance, and extraction efficiency. Surrogate compounds are compounds not normally found in environmental samples; however,

they are similar to the target analytes in chemical composition and behavior in the analytical process. Samples for organic analysis will be spiked with surrogate compounds consistent with the requirements described in the USEPA Methods and laboratory SOPs.

The goal for recovery of surrogates spiked into the sample matrix is 30-150%. Since sample characteristics will affect surrogate recoveries, the surrogate recoveries will be used as a measurement of accuracy of the overall analytical method on each individual sample. The surrogate recovery is calculated concurrently with the analytes of interest, using the equation in Section 2.2.2.

5.3 Instrument Calibration and Frequency

Analytical instrument calibration and maintenance will be conducted in accordance with the QC requirements identified in each laboratory SOP, laboratory QAM, USEPA guidance, and/or the instrument manufacturers' instructions. General requirements are discussed in the following sections.

5.3.1 Standard Solutions

A critical element in the generation of quality data is the purity/quality and traceability of the standard solutions and reagents used in the analytical operations. To attain the highest purity possible, the primary reference standards and standard solutions will be obtained from the National Institute of Standards and Technology (NIST), the USEPA repository, or a reliable commercial source, and will be traceable to NIST Primary Reference Standards. The laboratories will maintain written records of the supplier, lot number, concentration, receipt date, preparation date, preparer's name, method of preparation, expiration date, and other pertinent information for standards, standard solutions, and individual standard preparation logs.

Standard solutions will be validated prior to use. Validation procedures can range from a check for chromatographic purity to verification of the concentration of the standard solution using another standard solution prepared at a different time or obtained from a different source. Stock and working standard solutions will be checked regularly for signs of deterioration, such as discoloration, formation of precipitates, or change of concentration. Care will be exercised in the proper storage and handling of standard solutions. Containers will be labeled with the compound, concentration, solvent, expiration date, and preparation data (initials of preparer/date of preparation). Reagents will be examined for purity by subjecting an aliquot or subsample to the corresponding analytical method.

5.3.2 Balances

Analytical balances will be calibrated annually according to manufacturer's instructions and have a daily calibration check against NIST Class I weights before use by laboratory personnel. Balance calibration shall be documented in appropriate bound logbooks with pre-numbered pages.

5.3.3 Refrigerators

Laboratory refrigerators will be monitored for proper temperature by measuring and recording internal temperatures on a daily basis. At a minimum, thermometers used for these measurements will be calibrated annually, against a thermometer traceable to NIST.

5.3.4 Water Supply System

The laboratories will maintain an appropriate water supply system that is capable of furnishing American Society for Testing and Materials (ASTM) Type II polished water to the various analytical areas. This laboratory pure water shall not contain detectable concentrations of target analytes or interfering substances.

5.4 Laboratory and Field Instruments

Calibration of analytical instrumentation is required to document that the analytical system is operating correctly and functioning at the sensitivity required to meet project-specific DQOs. Each instrument will be calibrated with standard solutions appropriate to the instrument and analytical method, in accordance with the methodology specified and at the QC frequency specified in the laboratory SOPs.

The calibration and maintenance history of the laboratory instrumentation is an important aspect of the project's overall QA/QC program. As such, the initial calibration (ICAL) and continuing calibration verification (CCV) procedures will be implemented by trained personnel following the manufacturer's instructions and in accordance with applicable USEPA protocols to document the equipment is functioning within the tolerances established by the manufacturer and the method-specific analytical requirements.

5.4.1 Initial Calibration

The ICAL of instruments used for organic analyses of soil samples must be performed using a minimum of five standards for single-component target analytes and surrogates. The following criteria must be met for an ICAL to be considered valid:

- The relative standard deviation (RSD) shall be less than or equal to 20% for each compound included in the calibration standard.
- If RSD criteria cannot be met, linear or non-linear calibration models will be considered acceptable as long as the correlation coefficients are greater than or equal to 0.95.
- If a first order (linear) regression model is used for organic analytes, the line should not be forced through the origin, but have the intercept calculated from the five calibration points; the origin (0,0) must not be used as a fictitious calibration point. Additionally, the lowest calibration point must be at a concentration less than or equal to the method quantitation limit.
- If a second order (quadratic) model is used, six calibration standards must be analyzed instead of five. The curve must be continuous, continuously differentiable, and monotonic over the calibration range. The line must not be forced through the origin, but

have the intercept calculated from the six calibration points. In addition, the origin (0,0) must not be included as a seventh calibration point.

The ICAL of instruments used for the analysis of inorganic analytes will be conducted in accordance with the manufacturer's instructions and QC requirements identified in each laboratory SOP and QAM.

5.4.2 Continuing Calibration Verification

CCV standards will be analyzed at the beginning and end of the analytical sequence, according to method requirements to verify the calibration of the analytical system over time. If the response (or calculated concentration) for an analyte is within the method-specific acceptance limits of the response obtained during the ICAL (or the expected concentration) the curve is considered valid and analysis may proceed. Samples may not be analyzed unless the calibration curve is proven valid. The following criteria must be met for an ICAL to be considered valid:

- For the opening CCV, or closing CCV that is used as an opening CCV for the next 12-hour period, the %D must be within ± 15%.
- For the closing CCV, the %D must be within ± 50%.

5.4.3 Preventative Maintenance

Preventative maintenance on laboratory systems will be performed as needed. No project samples will be analyzed on a system that is not in good working order and properly calibrated.

6.0 DATA MANAGEMENT PROCEDURES

Project laboratories are responsible for generating, controlling, and archiving project laboratory and field reports. This information should be maintained with a system that is effective for retrieval of documentation that affected the reported results. This includes record generation and control, security, and maintenance for the project related documents.

6.1 Data Reduction and Reporting

The data will undergo a final review by the contractor, including an examination of the results for field duplicates, MS/MSDs, and laboratory blanks to document they are acceptable. This will also include comparing the sample descriptions with the field sheets for consistency and document that anomalies in the data are appropriately documented.

Sections 6.1.1 through 6.1.5 describe the data reduction, review, and deliverables associated with the field and laboratory data.

6.1.1 Field Data Reduction, Review, and Deliverables

Field data will be reviewed by the Field Manager. The Field Manager will debrief field personnel during sampling events and identify anomalous data or observations. The Field Manager will evaluate if action needs to be taken and make recommendations to the Project Manager.

6.1.2 Laboratory Data Reduction, Review, and Deliverables

The project laboratory shall deliver final results in hardcopy and portable document format (pdf) data packages or pdf-only data packages no later than 21 days (standard turn-around time) after receipt of the samples by the project laboratory.
It is possible that expedited turn-around time may be required on some project samples. If this is the case, it is expected that project laboratories will make a reasonable effort to accommodate the expedited schedule.

Data generated by the project laboratory will undergo data reduction and review procedures described in the laboratory QAMs and SOPs. Data generated, reduced, and reviewed by the laboratory will undergo a comprehensive data review by a QA reviewer or designee. (See Section 8.0)

USEPA Contract Laboratory Program (CLP)-equivalent deliverable requirements will be employed for documentation and reporting of analytical data. CLP report forms will not be required.

6.1.3 Laboratory Data Reduction

Each project laboratory will perform in-house analytical reduction under the direction of the laboratory QA Manager. Laboratory reduction procedures will be those adopted, where appropriate, from SW-846 (USEPA, 1992 et subsequent) and those described in the laboratory

QAM. The data reduction steps will be documented, signed, and dated by the analyst or designee. Data reduction will be conducted as follows:

- Raw data produced by the analyst will be processed and reviewed for attainment of QC criteria for overall reasonableness and for calculation or transcription errors, as outlined in this document and/or an established USEPA method.
- Data will then be entered into the laboratory information management system (LIMS) and a computerized report will be generated and sent to the laboratory QA Manager or designee for review.

Laboratory qualifiers as described and defined in the laboratory QAM will include, but are not limited to:

- Concentrations less than required reporting limits;
- Concentrations greater than the instrument's calibration range;
- Estimated concentrations due to poor spike recovery;
- Concentrations of the analyte detected in the laboratory blank; and,
- Other sample-specific qualifiers necessary to describe QC conditions.

The laboratory will maintain detailed procedures for laboratory record keeping to support the validity of analytical work. Each data report package submitted will contain the laboratory's written certification that the requested analytical method was run and that QA/QC checks were performed. The laboratory program administrator will provide QC reports of the laboratory's external audits, if appropriate, which will become part of the project file.

6.1.4 Laboratory Data Review

The laboratory data review process involves evaluation of both the results of the QC data and the professional judgment of the person(s) conducting the review. This application of technical knowledge and experience to the data evaluation is essential to ensuring that high quality data are generated. Each project laboratory has documented procedures, which are to be followed and must be accessible to laboratory personnel. The data review is generally conducted in a three-step process at the laboratory prior to generation of the final data package:

- Level 1 Analyst/Peer Data Review – The analysts review the quality of their work based on an established set of guidelines. The review will document at a minimum that: appropriate preparation, analysis, and SOPs have been followed; analytical results are correct and complete; QC samples are within established control limits; and that documentation is complete (e.g., anomalies have been documented).
- Level 2 Supervisory Data Review – A supervisor or data review specialist whose function is to provide an independent review of the data package will perform this level of review. This review will also be conducted according to an established set of guidelines (including method requirements and laboratory SOPs). The Level 2 review includes a review of the qualitative and quantitative data and review of documented anomalies.

- Level 3 Administrative Data Review – A laboratory QC Manager or equivalent performs the final data review, prior to submittal. This level of review provides a total overview of the data package to document its consistency and compliance with project requirements. The project laboratory QA/QC Officer or designee will evaluate the quality of the work based on this document and an established set of laboratory guidelines to document the following:
    - Sample preparation information is correct and complete;
    - Analysis information is correct and complete;
    - Appropriate procedures have been followed;
    - Analytical results are correct and complete;
    - Laboratory QC check results are within appropriate QC limits;
    - Special sample preparation and analytical requirements have been met;
    - Documentation is complete (anomalies in the preparation and analysis have been documented; holding times are documented); and,
    - Laboratory qualifiers have been assigned to samples, as appropriate.

6.1.5 Laboratory Data Deliverables

Upon acceptance of the data by the laboratory QC Manager, or designee, deliverables will be generated and submitted to the contractor. The contract laboratory will maintain detailed procedures for laboratory record keeping, supporting the validity of analytical work. Each data report package will contain the laboratory's written certification that the requested analytical method was run and that laboratory QC checks were performed.

6.2 Field Document Control and Records Management

Project-specific records that relate to field work performed will be retained for a minimum of five years. These records may include correspondence, COC records, field notes, and reports issued as a result of the work. In addition, records that document the field operations will be retained. This may include equipment performance records, maintenance logs, personnel files, general field procedures, and corrective action reports. Electronic or hard copy records of field operations are acceptable.

6.3 Laboratory Document Control and Records Management

The laboratory prepares and retains full analytical and QC documentation that can be tracked from initiation to disposal for each sample. The following minimum records should be stored for a minimum of five years for each project:

- Original work order, COC, and other pertinent documents received with the samples;
- Communications between the laboratory, field, and the customer;

- Associated corrective actions;
- Laboratory data packages;
- Finalized data reports;
- Laboratory log books; and,
- Electronic data.

The laboratory should also maintain its QAM and related SOPs for the methods performed.

7.0 ASSESSMENT/OVERSIGHT

7.1 Performance and System Audits

Proper communication between field personnel, project management personnel, and laboratory personnel will help to establish that the proper methods and techniques are used throughout the project.

The Field Manager will be responsible for supervising and checking that samples are collected and handled in accordance with this QAPP and that documentation of work is adequate and complete.

The laboratory QC Manager will have the responsibility of ensuring that their analytical laboratory is following in-house performance and performing system audits under their in-house QA/QC guidelines. A laboratory will immediately deal with irregularities found in its performance or system audits. The laboratory QC Manager, or designee, will also conduct the following internal audits regularly:

- Technical audit including reviews of calibration and equipment monitoring records, laboratory logbooks, maintenance records, and instrument control charts;
- Data quality audit reviews, including aspects of data collection, reporting, and review; and,
- Management systems audits verifying that management and supervisory staff are effectively implementing and monitoring QC activities necessary to support the laboratory QA program.

The Project Manager is responsible for overseeing that the project performance satisfies the QA objectives as set forth in this document. Reports and technical correspondence will be peer reviewed by qualified individuals before being finalized.

7.2 Corrective Actions

Audits and other assessments may reveal findings of practices or procedures that do not conform to this QAPP. The following sections describe appropriate corrective actions for the various data management activities.

7.2.1 Field Corrective Action

The Field Manager will review the procedures being implemented in the field for consistency with the established protocols. Sample collection, preservation, labeling, etc. will be checked for completeness. Where procedures are not strictly in compliance with the established protocol, the deviations will be field documented and reported to the Project Manager, and the documentation will become part of the project file.

7.2.2 Laboratory Corrective Action

The project laboratory QC Manager will be responsible for the review of the data generated by their laboratory to document that QC samples have been run as specified in the protocol. Recoveries of LCSs, surrogates, and MS/MSDs will be reviewed for method accuracy. The RPD of laboratory duplicates and MS/MSDs will be reviewed for method precision. Laboratory personnel will be alerted that corrective actions are necessary if any of the following occur:

- The QC data are outside the warning or acceptance limits for precision and accuracy established for LCS. The laboratory QC Manager will consult the Project Chemist or the Project Manager to discuss out-of-control data sets.
- Blanks contain contaminants at concentrations greater than the reporting limit.
- Undesirable trends are detected in the LCS or MS percent recoveries, RPDs, or surrogate recoveries.
- Unusual changes in detection limits are observed.
- The laboratory QC Manager detects deficiencies during internal or external audits, or from the results of performance evaluation samples.

If the analyst identifies nonconformity in the analytical methodologies or QC sample results, the laboratory will implement corrective actions immediately.

The analyst will review the preparation or extraction procedures for possible errors, check the instrument calibration, evaluate spike and calibration mixes, check instrument sensitivity, and will initially handle corrective action procedures at the bench level. The analyst will immediately notify his/her supervisor of the identified problem and the investigation that is being conducted. If the problem persists or cannot be identified, the matter will be referred to the laboratory supervisor and laboratory QC Manager, and if the data are impacted, the Project Chemist and Project Manager will be provided a corrective action memo for inclusion in the project file.

Corrective action may include, but will not be limited to, the following:

- Reanalyzing suspect samples if holding time criteria permit;
- Retrieving the archived sample for analysis;
- Accepting data with acknowledged level of uncertainty (with consultation);
- Recalibrating analytical instruments;
- Evaluating and attempting to identify data limitations; and,
- Resampling.

7.2.3 Corrective Actions Following Data Evaluation

The Project Chemist will be responsible for reviewing the laboratory data generated for the Tower project and documenting that project QA/QC objectives are met. If nonconformances are

found in field procedures, sample collection procedures, field documentation procedures, laboratory analytical and documentation procedures, or data evaluation and quality review procedures, the impact of those nonconformances on the overall project QA objectives will be evaluated. Appropriate actions, including reanalysis or resampling, will be recommended to the Project Manager so that the project objectives can be accomplished. Data deemed unacceptable by the Project Manager, following the implementation of the required corrective action measures, will not be accepted and further follow-up corrective actions will be explored.

7.3 Reports

A data quality review summary will be prepared at the end of data collection activities for the Tower project and included in the final report. This summary will include discussion of data quality as determined during the data review and assessment process described in Section 9 of this QAPP.

8.0 DATA REVIEW, VERIFICATION, VALIDATION, AND ASSESSMENT

One hundred percent (100%) of data collected from field events conducted for the Tower project will undergo data quality review and 20% of data will undergo data validation.

8.1 Completeness Check

At a minimum, data collected from the Tower Site will undergo a completeness check. Data will be reviewed to document that: data are present; the correct analytical methods were used; and that appropriate QC samples were analyzed. Completeness checks will not be recorded in written reports and data will not be qualified based on the results of these checks. However, if major QC issues are discovered during the completeness check, further investigation will be undertaken.

8.2 Data Quality Review

Data quality review is an evaluation of laboratory data performed by an experiences analytical chemist. Data quality review does not include verification or validation of the raw analytical data. Data quality review findings will be recorded in a written summary. If major QC issues are discovered during the data quality review, full validation may be warranted. It is anticipated that 100% of the data collected from the Tower Site will undergo data quality review.

8.3 Data Validation

Data validation is a comprehensive evaluation of laboratory data by experienced analytical chemists. It involves complete review of raw data associated with the project samples in a process that includes reconstruction and verification of initial calibrations, and recalculation of sample results from instrument printouts and sample preparation bench sheets.

Validation will be performed according to the current CLP guidelines for organic and data review, SW-846 Method requirements, and project-specific requirements specified in this QAPP. Results of the data validation will be presented in a Data Validation Report. It should be noted that full validation requires raw analytical data, which may not be present in the laboratory's standard data package, and which may incur additional cost. It is anticipated that 20% of the data collected from the Tower Site will undergo data validation.

8.3.1 Data Quality Review or Data Validation Report

The data quality review summary and data validation report will summarize the performance of the project team in meeting the QA criteria outlined in this QAPP. The data quality review and data validation report will include, but is not limited to:

- Compliance with this QAPP;
- Chain-of-custody documentation;
- Compliance with all holding times;
- Instrument calibration;

- Compliance with project-specific reporting limits;
- Field and laboratory QC samples (precision and accuracy);
- Field and method blanks; and,
- Discussion of limitations on data usability.

8.4 Data Qualification

Data will be qualified based on the findings of the data verification and validation process. The data qualifiers used for this project will be taken from the USEPA National Functional Guidelines for Superfund Organic Methods Data Review (USEPA, 2008), and will consist of, at a minimum:

U The analyte was analyzed for, but was not detected at a level greater than or equal to the level of the adjusted quantitation limit for the sample and method.

J The analyte was positively identified and the associated numerical value is the approximate concentration of the analyte in the sample.

UJ The analyte was not detected at a level greater than or equal to the adjusted quantitation limit; however, the reported adjusted quantitation limit is approximate and may be inaccurate or imprecise.

R The sample results are unusable due to the quality of the data generated because certain criteria were not met. The analyte may or may not be present in the sample.

REFERENCES

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USEPA, 2006. EPA QA/G-4, Guidance on Systematic Planning Using the data Quality Objective Process. EPA/240/B-06/001, February 2006.

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USEPA, 2008. USEPA Contract Laboratory Program National Functional Guidelines for Superfund Organic Methods Data Review, Final, EPA-540-R-08-01, June 2008.

LIMITATIONS

This plan was prepared exclusively for Tower Automotive Operations USA I, LLC by AMEC Environment & Infrastructure, Inc. (AMEC). The quality of information, conclusions, and estimates contained herein is consistent with the level of effort involved in AMEC services and based on: i) information available at the time of preparation, ii) data supplied by outside sources, and iii) the assumptions, conditions, and qualifications set forth in this report. This Quality Assurance Project Plan is intended to be used by Tower Automotive Operations USA I, LLC for the Elkton, Michigan Plant only, subject to the terms and conditions of its contract with AMEC. Any other use of, or reliance on, this plan by any third party is at that party's sole risk